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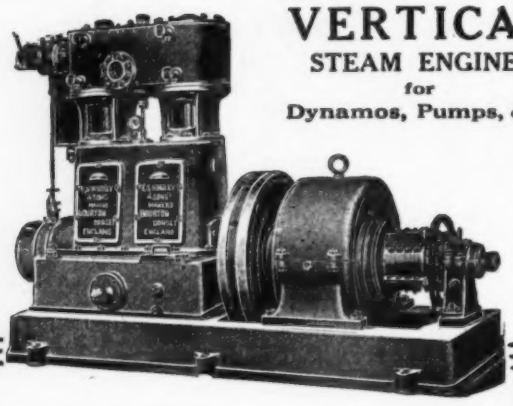

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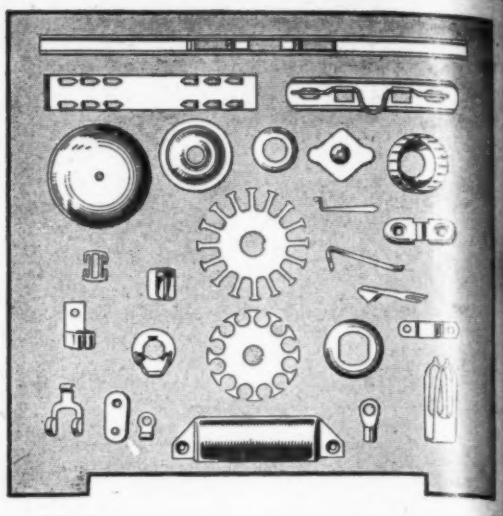

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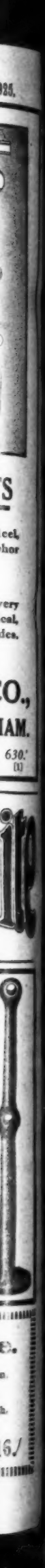

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Trade Investigations.

MANUFACTURERS and traders accept the item of "bad debts" with equanimity as long as they do not exceed a certain percentage of the total business done; practically everybody has to run reasonable risks in order to do any trade at all.

In the Home trade sometimes it is impossible to avoid losses when dealing with customers who are close at hand; but operations in export markets present greater difficulty. There are certain countries where it is necessary to be constantly studying the local black lists or conferring with the Consular representatives, Chambers of Commerce, or branch offices of Home trade associations before estimating the risks. But excessive caution even there is not a help to trade expansion. One must avail oneself of all the available business intelligence facilities and be prepared to take definite action accordingly. We need all the export trade that we can secure, and if we go in for this branch of business we must not be contented with a policy of half measures; we must be neither too hesitating nor too nervous in shouldering risks provided that they are reasonable.

Nearly a year ago we reviewed the question of bankruptcies in the Home electrical and allied trade, and our remarks aroused a good deal of interest, but we are not aware that any special effort has yet been made to improve the state of affairs or to prevent undesirable things from happening.

It is true that last year a Government Committee went into the whole subject of bankruptcy law, and expressed the opinion that wide measures of reform were urgently needed; and it is said that its recommendations may shortly be published. It is expected that the Government now in office will introduce legislation to prevent defaulting bankrupts from carrying on trade and continuing to receive credit under the protection afforded to limited liability companies, and also to prevent fraudulent practices on the part of companies themselves. But whatever legislation may be introduced,

there will remain many matters of the kind mentioned, which will require the existence of an ever-watchful intelligence service along associated lines.

Judging from statements just published, the last three or four years have been a particularly disastrous period for manufacturers in certain trades (especially textiles), they having been victimised to the extent of many millions of pounds by long-firm frauds, bogus bankruptcies, &c. Aliens who have started firms here since the war seem to have been a particular source of trouble. It appears that the manufacturers' associations by acting in conjunction with the Criminal Investigation Department have been able to break up several organised gangs, a circumstance which emphasises the necessity for traders to act together for their self-protection in such matters.

We observe from the financial Press that the subject is exercising the minds of leading business men in South Africa, and electrical and allied exporters who have transactions in that market should be interested in what they are doing. They have frequently expressed their concern at the large annual crop of bankruptcies and, according to the *Financial Times*, have urged that legislation should be introduced to prevent fraudulent insolvencies, but they have now decided to proceed to form an organisation of their own and not to wait longer for official action. The object of the new organisation, which has been started at Johannesburg, is to prevent fraudulent bankruptcies and avoid bad debts due to similar causes. Many of us know from practical experience how very difficult it is to track right down to the point of prosecution those who engage in a long-firm swindle or who act in a "smart" way when a business is just going into bankruptcy or liquidation. One may have a sheaf of documentary proofs regarding dishonest practices, but individual parties who have been defrauded shrink from taking action, and the authorities, while they will courteously take a note of your information, cannot go as far as the interests of the trade would appear to render desirable.

Joint action on the part of manufacturers and traders in pursuing and prosecuting rogues, if it can be swift in operation, should be more successful. But joint action in preventing failure, and especially fraudulent failure, would be better still, because it keeps an effective lock on the stable door and turns the key in time. What the Johannesburg traders are doing is the dual service of preventing losses wherever possible and insuring each other against them when they are unavoidable. Bad debts will be prevented by a merchant's asking the organisation to keep a close watch on the business and books of a customer to whom he is giving credit; but when they are incurred, the loser will be recompensed to the extent of 75 per cent. of his bad debts under a scheme of co-operative insurance.

There may be nothing novel about the idea of insurance against bad debts, but the idea of co-operative action in collecting business information, which has inspired those who have established the organisation, might well be studied by sections of the electrical and allied trade in both the Home and the Overseas markets. The South African organisation will act as "a continual auditor, accountant and stocktaker" to those requiring credit, and will have power to obtain information from banks, merchants, shippers, &c., as well as to impart information to its members. The day-to-day actual position and contingent liabilities of credits used will be checked, tabulated, and analysed; there will be a register of credit customers, status investigation records, and periodical checking of lists of sundry debtors. Other duties undertaken will be the taking of stocks without warning, and steps for preventing the indiscriminate signing of bills, bonds, or similar documents.

It will be very interesting as time goes on to learn whether the organisation has been able to carry out its intentions without having too great a restraining influence on business.

Wembley Exhibition Plans for this Year.

WITH the general discussions that have arisen regarding the desirability or otherwise of the Wembley Exhibition being re-opened for a second period we have little concern here. The Government has approved, and is prepared to give increased financial guarantees, various parts of the Empire are continuing their support and, given reasonable regard for its pocket by the Exhibition authorities and for its convenience by the elements, the public may be expected to patronise the undertaking in search of amusement and of Empire information. The expenditure which British manufacturers and traders incurred in connection with their 1924 exhibits was a heavy burden, and it was originally shouldered as a quite special matter which could rightly be regarded as an outlay covering many years; it was not contemplated that it would recur, even on the somewhat smaller scale that continuation involves. Though it could never have been anticipated that the British electrical and other engineering industries would so soon repeat their associated organised efforts on the magnificent scale that marked the 1924 Exhibition and leaves the display of the Palace of Engineering the finest and biggest that the world has seen, the Exhibition authorities are hoping for large support from individual manufacturers. With the opening of the New Year they have approached those who took part last year with certain concessions, including reduced charges for stand space in the Palace of Engineering; and as there are only about four months to the re-opening, they should shortly know what floor space will be required for engineering, including electrical exhibits. The Palace of Engineering and the Palace of Industry are both huge halls, and will take a lot of filling. In some quarters it has been suggested that certain large industrial exhibits may find their way into the same building as the engineering exhibits this time, but we have no definite knowledge on this point. It is reported—we do not know on whose authority some of the Press statements have been made—that the Palace of Industry promises to be filled to overflowing, and that for any exhibitors who wish to drop out there will be plenty of others to take their places. So far as we can judge, there is little disposition on the part of either the electricity or the gas interests to dip into their resources heavily for co-operative popular displays. Yet, considered electrically, it is impossible not to feel that where the throng goes, even on pleasure bent, there is an excellent opening for an attractive popular demonstration. Possibly, though this may not be found practicable through the established organisations, there may be some ground for suggestions of an electric village or town organised by a few manufacturers and traders co-operatively, which recently appeared in the daily Press.

Sir Travers Clarke, the Chief Administrator, has replied to certain constructive criticisms offered by the Federation of British Industries. He says that the Executive did its utmost to defeat attempts that were made to introduce foreign goods into the 1924 Exhibition, and expresses the hope that, profiting by last year's experience, it will be able to ensure that the 1925 collection "will be entirely British in so far as that is practicable." He also states that proposals are under consideration for securing that on one day a week there shall be "as little interference as possible with the close study of the exhibits by business men"; and he asks the Federation to give all the weight of its great influence toward helping the Exhibition to success.

Tramway Statistics.

THE impressions to be gained from the latest Ministry of Transport returns relating to tramways and light railways in Great Britain are varied. It is satisfactory to note that, in the aggregate, tramways were able to contribute more to the relief of rates than they took from this source, the favourable balance being £23,760, whereas in the preceding year there was an unfavourable balance of £111,147.

On the other hand, the ratio of expenses to receipts increased from 76.23 to 77.74 per cent., carrying the proportion still further from the 1913-14 figure—64.51 per cent. The increased ratio is probably explained by the fact that while the number of car-miles run increased by 3.17 per cent. compared with 1922-23, the number of passengers increased by only 2.18 per cent. The "load factor" is, however, much better than in the last pre-war year, for while the number of passengers has increased by 34.57 per cent., the number of car-miles shows an advance of only 7.12 per cent. Another factor leading to increased expenses was the slightly higher energy consumption per car-mile, giving rise to a total increase of 34 million kWh, or 5.31 per cent.,

As regards the local authority undertakings, out of 156 in operation during the year only 98 were able to meet all their charges in full (five more than in 1922-23), while the number of undertakings which were unable to cover their working expenses rose from 6 to 11.

The number of railless trolley undertakings in operation during the year was 14, the West Hartlepool, Ipswich, and Wolverhampton Corporations having inaugurated railless systems. A better "load factor" is recorded; while the number of passengers carried increased by 56.2 per cent., the car-mileage advanced 36.6 per cent.

The Telephone Breakdown.

WHILST the Post Office has been getting into very hot water owing to its failure to deal with the heavy Christmas postal traffic in letters, parcels, and newspapers without "abnormal delay," the converse has occurred in connection with its telephonic communications, the excessive supplies of cold water with which we were douched at the turn of the year having found the weak places in the underground cables. The devastation caused by the gales in respect of the overhead lines was excusable; the Post Office lines are constructed to a very stiff specification, and are maintained in good order, but the violence of the storm was irresistible, and some 230 main trunk lines were interrupted.

We were, however, under the impression that the main purpose of putting the trunk lines between important centres underground was to ensure freedom from breakdown due to storms, and it is disconcerting to find that this object has not been wholly attained. Communication with Bristol, Cardiff, Glasgow, Dublin, Manchester, Newcastle and other important cities was seriously restricted, and the Continental services suffered severely. Local telephone services were disorganised by the failure of junction lines due to the ingress of water. But water is what one expects to find underground, and the first essential of a cable is that it shall be waterproof under all conditions. Hence the failure of the underground system is somewhat disappointing. We hope that the lesson will be laid to heart and that every effort will be made to ensure the reliability of the telephone service in spite of storm and flood. It was a singular but fortunate circumstance that telegraphic communication suffered comparatively little from the rough weather.

Irish Water Power.

THE experts' approval of the scheme submitted by the Siemens-Schuckert Co. for the development of the River Shannon as a source of energy brings this matter prominently before the public; it now remains for the Free State Government to decide whether to adopt the scheme or not, and in the former event, whether the undertaking shall be carried on by the State or by private enterprise. The probabilities appear to be in favour of State ownership, and in that case the question of finance will arise; the cost of the scheme in the first instance is estimated at £5,200,000, a sum which can hardly be raised by the Free State Government on terms that could be regarded as commercially acceptable. The contract with the German firm secures to it the option of taking over the scheme if the State does not handle it, but as stated in our last issue, German financial backing for the scheme is not contemplated.

It would appear, therefore, that if the scheme goes forward, an appeal must be made to British financiers to provide the funds, and we strongly deprecate their accepting any share in the responsibility. Whether the Free State Government or the German company is in charge of the work, it is a moral certainty that the whole of the plant will be manufactured in Germany, and the civil engineering work on the site will, of course, be done by native labour; hence the scheme offers no prospect whatever of relieving unemployment in this country, and it has no other claim to consideration or support on the part of our people.

Apart from the question of capital expenditure, the commercial prospects of the undertaking are by no means satisfactory. As we pointed out in our issue of March 21st, 1924, the Commission of Inquiry into the Resources of Ireland, with the records of the flow of the Shannon for 30 years before it, estimated that the river could produce an average of 52,000 h.p., provided that a very large water storage scheme was carried out. Messrs. Siemens-Schuckert's figure of £5,200,000 suggests that they have estimated on the basis of £100 per horse-power, which is an extremely heavy outlay; their estimated output of 150 million kWh per annum supports this conclusion, as it corresponds with a load factor of about 50 per cent.—an optimistic figure, but not, perhaps, unreasonable under the circumstances. At present, it is stated, the demand amounts to only 50 million kWh, and until new demands are created to absorb the additional output it will be impossible to supply energy at a price that will compare favourably with that of energy produced from coal. Even when the full output of the initial development is attained—say, 150 million kWh at as high a price as 1d. per kWh—the revenue will only be £625,000, which would barely suffice to cover interest and sinking-fund charges, plus management and maintenance costs. And a steam station which could not supply in bulk at less than 1d. per kWh with a 50 per cent. load factor would be a sorry example of present-day engineering.

The paper by Mr. J. Murphy on the small hydro-electric plant at Bandon, Co. Cork, which is abstracted in this issue, serves to show, though in miniature, the wide variations in the power available and the extreme difficulty experienced in utilising water-power to advantage in Southern Ireland. On a larger scale the difficulties would be correspondingly magnified.

However, the Irish are ruled by sentiment, and if it is decided to use Irish water rather than English coal, and pay a high price for the privilege, no one need be surprised.

X-ray Martyrs.

IN spite of the increase of knowledge regarding the properties of X-ray radiation and the risks attending its use, the list of those devoted men who have been maimed or have already succumbed to their injuries continues to lengthen. We learn with regret from the daily Press that Major Hall Edwards, whose sufferings have been previously recorded in our pages, is dangerously ill. M. Demenitroux, who collaborated with M. and Madame Curie, the discoverers of radium, died on January 3rd, at the early age of 48, from burns which he received during his researches, and Prof. Bergonié, who had made a special study of the curative value of radium in cases of cancer, and was also a distinguished worker with Roentgen rays, died on January 2nd. Prof. Bergonié was in his sixty-eighth year, but had undergone several operations and suffered the loss of his right arm as the result of X-ray burns, and his death followed a long and painful illness. He had accomplished a vast amount of work, and was recently made a member of the Legion of Honour.

These men have truly given their lives in the cause of humanity, and their works live after them.

E

The World's Largest Engineering Project.—II.

The Undertaking of the Southern California Edison Co.

By T. B. ROSS.

(*Concluded from page 23.*)

In the more populated areas, the distribution lines from the sub-stations have until recently carried the company's standard voltage of 2,300, but owing to the ever-increasing demand for current as the population and industry of Southern California have grown, the load has increased beyond all expectations, and here, again, the company has had to seek some new means of coping with existing requirements and also making arrangements for future growth. The telephone and telegraph companies operating in the company's territory utilise by agreement the poles of the So. Cal.

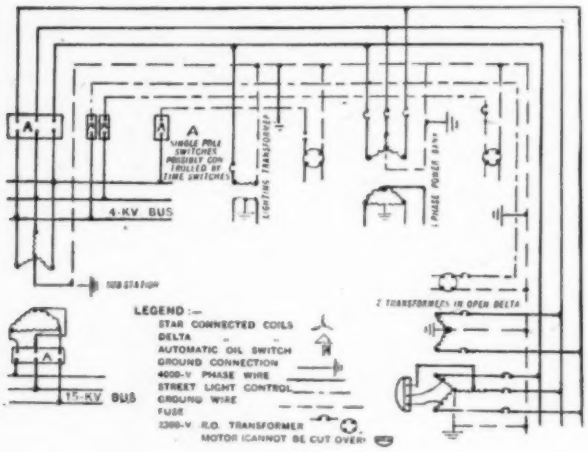


Fig. 10.

Edison Co. to carry their respective lines, and their limit of protecting insulating apparatus is restricted to 5,000 volts, which figure has been fixed by the Railway Commission. The company had numerous ways of overcoming the increasing difficulties of meeting the fast-growing demand for current, but all more or less meant prohibitive cost of handling the smaller loads, and ultimately it was decided to adopt a higher voltage over the same wires, insulators, and pole lines. Quoting from one of the company's monthly publications, "Edison Facts," issued to employés, the following will explain the new methods now being adopted.

"Only two standard voltages remain from which to choose, *viz.*, 4,400 volts delta or 4,000 volts star.

"If 4,400 volts delta were chosen, it would be necessary to change all the transformers on the lines, the station transformers, regulators, and all other equipment designed for 2,300 volts, and none of the old transformers removed from the lines could be used again. This would mean an enormous loss when it is considered that there are about 14,000 2,300-volt transformers on the system. Therefore, the logical voltage to use is 4,000 volts star, and it presents the following advantages:—The present station transformers can be used, connecting them star on the secondary instead of delta; the present line transformers can be used reconnecting them star on the primary side, and, in the case of lighting transformers, by reconnecting them from one phase wire to the neutral ground wire, and the same wire, insulators, cutouts, and pole-top switches can be used as at present. The station regulators will have to be changed, as now they are all three-phase, 2,300 volts, the primary being star connected. It will be necessary to make some changes in current transformers, switches, &c., but the expense involved is not very great.

"Further advantages in using 4,000-volt as against 2,300-volt distribution are as follows:—In congested districts where the circuit switches and other equipment are loaded to their current-carrying capacity, the capacity in kVA of the circuit can be increased by 73 per cent. without any increase in current, and with this additional load the per cent. of voltage drop to the consumer will be reduced to 57 per cent. of what it was at 2,300 volts. In the sparsely-settled territory where the equipment is not fully loaded in amperes, but the voltage drop is the limiting factor due to long lines, by changing to 4,000 volts the load can be increased 200 per cent. with no greater per cent. drop, or, on the other hand, the lines can be three times as long with the same load and no greater per cent. drop, or with no increase in load the per cent. drop will be but 33 per cent. of what it was at 2,300 volts. The per cent. of energy lost with the same load at 4,000 volts would be reduced to 33 per cent. of what it was at 2,300 volts. The reduction in voltage drop would increase the quality of Edison service, and the decrease in line loss, increase the efficiency of the distribution system, two factors that the Operating Department are continually striving to attain.

"Among the several methods of wiring which can be used on such a 4,000-volt system are the three-wire system, with the neutral grounded or ungrounded at the station, the four-wire system, with the neutral totally ungrounded or grounded at the station only, or the four-wire with the neutral grounded at the station, at all power banks and at numerous other points along the line. Considering the fact that about 80 per cent. of the 2,300-volt transformers in the territory under consideration are now connected for lighting only, and would have to be changed to 4,000 volts each if a three-wire system were adopted, and considering that there would be two different voltage transformers in stock and installed on the same line, with a possibility of mistakes being made, and that approximately 80 per cent. of the business taken on these lines would have to carry the additional cost of the higher voltage transformers, it would seem that the three-wire, 4,000-volt system was not the one for the Edison Company to adopt.

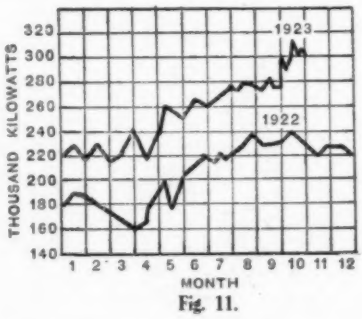


Fig. 11.

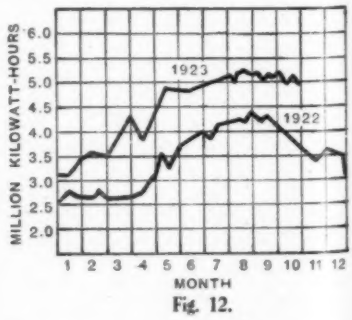


Fig. 12.

"With the four-wire, 4,000-volt system, all the company's present transformers can be used. With a totally ungrounded system, all four wires would have to be considered hot at all times, and in case of an accidental ground on one of the phase wires, the neutral would have a potential of 2;300 volts above ground and the other two phase wires would be 4,000 volts above

ground, a condition which might cause failure of the insulation of the transformer or bushing, or other equipment designed for 2,300 volts. Also, if the neutral wire should accidentally become opened, any unbalance in the lighting load beyond the break would give unbalanced voltage. With the neutral grounded at the station only, an accidental ground on a phase wire at some distance from the station will have nearly the same effect as mentioned above until a circuit breaker goes out, and if the point is far enough distant from the station, and the ground exceedingly dry, the breaker may not go out.

"This leaves the last, and, in the opinion of our engineers, the best system to adopt, that is, the 4,000-volt, four-wire system, with the neutral grounded at the station and at all power banks, and if the power banks are too far apart, additional grounds should be installed at several points along the line. This method has all the advantages of the 4,000-volt system with added safety, due to the fact that the neutral wire is at ground potential at all points, and if the neutral wire should become open, the system would still be stable beyond the break; also, if a phase wire accidentally becomes grounded, the circuit breaker will go out immediately, as the path for the ground current through the earth is of lower resistance on account of the multiplicity of grounds."

It is claimed that by conversion of the distribution system from 2,300 V to 4,000 V, utilising the present wiring, poles, &c., the saving effected by not using special 4,000-V transformers is equal to the cost of installing 1,500 miles of neutral wire. In carrying out the change-over to 4,000 V it will be necessary to install a fourth wire, this being the ground or star neutral wire, which will be specially placed and carried on a white insulator for purposes of identification. Probably by this date all of the company's stations have now cut over to the new higher voltage of 4,000. Fig. 10 shows in outline the system adopted.

The two charts printed herewith, figs. 11 & 12, indicate the loads handled by the company's various plants for the years 1922 and 1923 (10 months only).

Of interest to electric motor designers and manufacturers will be the adoption by the company of a recently-invented device known as the synthermal fuse. This new fuse contains a heating element embedded in an alloy and acts as a heat ballast, following the heating curves of the motor which it protects. It is stated that this type of fuse is giving excellent results.

Although the project is primarily dependent on hydro-electric generation, the company has a number of large steam plants in operation, particularly down on the coast, and these plants have at times to be run at their utmost output when occasion calls. The largest of these steam plants is to be found down at Long Beach, where 63,000 h.p. is at present developed. It was decided last year to increase the capacity of the Long Beach plant by the addition of two 35,000-kW horizontal steam turbine-driven generators, and these are expected to be in operation some time this year. Four new 60,000-volt circuits will be constructed on a new steel tower line to handle the distribution of this additional power. The boilers will be fitted with combination oil- and gas-burning furnaces, designed by the company's own engineers, and will be capable of changing over from oil to gas or *vice versa* at a few minutes' notice. The new steam turbines will be supplied with steam from eight 1,600-h.p. boilers of the latest design fitted with superheaters and economisers, with a working pressure of 375 lb. per sq. in. The turbines will operate at 350-lb. pressure and 700 deg. F. total temperature, giving a superheat of about 260 deg. F., and will have a steam consumption of about 10 lb. per kilowatt-hour.

There is an over-abundance of natural gas from the near-by oil fields of Signal Hill (one of the recent oil discoveries of Southern California), and the company has contracts with the Southern Counties Gas Co. for supplying natural gas from the Signal Hill Field in sufficient quantities to meet all fuel requirements for the Long Beach steam plant for a period of five years. The natural gas is conveyed under a 30-lb. pressure through one 18-in. and one 8-in. supply pipes, being delivered at the plant at not less than 7-lb. pressure, where it passes through a pressure regulator to give the uniform pressure required.

The specified heating value of this natural gas is fixed at not less than 960 B.th.u. per cubic foot, and it is expected that the heating value will run considerably higher than the minimum stipulated in the contract. It has already exceeded 1,200 B.th.u. during the latter half of 1923 and, as a result, the company records a saving of 35 per cent. in fuel, amounting to over $200,000 per annum, by using gas fuel instead of oil fuel. It is estimated that the use of natural gas by the company at its Long Beach plant will in time be in the vicinity of 1,500,000,000 cubic feet a month, and at the present time about 20,000,000 cu. ft. of gas is consumed daily, which gas would in all probability be wasted at the oil fields on account of the great excess of gas supply. Engineers at home must feel that Southern California has been blessed with a surfeit of good things in their own particular line when they commence to study the many natural resources of the country, but California has one severe handicap in its lack of coal and coke for the development of blast furnaces and the production of pig iron. However, even this problem is being tackled, and once pig iron can be produced on that coast in large quantities at competitive prices with Pittsburgh and other centres, the phenomenal growth of the last 15 to 20 years applying to Los Angeles and Southern California will most likely be eclipsed over the ensuing similar period ahead.

It is stated by the company that a more diversified use of electricity is to be found in California than in any other part of the world, and that its system supplies 312 cities and towns throughout its territory. Four railways are supplied with Edison current for traction and other requirements, these being the well-known Pacific Electric, the Los Angeles Railway, the Santa Barbara and Suburban, and the Visalia Electric.

The company lights hundreds of miles of streets and highways, and caters generally for almost the whole electrical requirements of Southern California. The city of Los Angeles has its own municipal light and power plant, but even this is greatly dependent at times on extra supplies from the Edison Company, and only caters for a part of the city's population.

As a result of the company's great accomplishments in this big undertaking, it was awarded last year the Charles A. Coffin medal "for the greatest contribution to the development of electric light and power for the convenience of the public and the benefit of the industry for the year 1922." This medal is one of the most highly-prized awards in the electrical industry of America and is open to annual competition to all the public utility companies in the United States.

This Edison project is so vast that one becomes almost bewildered when trying to describe to others some of the principal accomplishments of the undertaking, and a personal visit is the only possible way of being able to fully appreciate all that the company has set itself to do in catering for the present and future requirements of the people settling in the territory covered. Trade associations and other interested parties from all over America and Canada pay visits to the Edison project, and it might well be worth the while of a British engineering institution to arrange a visit of some of its members and other trade friends to the Southern California Edison Company's field of operations, at the same time taking in, *en route*, some of the other big American engineering plants and completing the tour by returning to England *via* the Panama Canal. Such a visit from British engineers could not fail to be productive of much good, both from a national and professional point of view. Should such a trade tour be made, those participating would, the writer believes, be assured of a hearty welcome from the American engineers and be given every facility for studying their splendid engineering triumphs.

Unfair Competition.

(A few Notes.)

By "JUST BIDE A WEE."

It is surprising to note the lack of unanimity among electrical men respecting the vexed question of unfair competition. So divergent are some views on the subject that it must be concluded that the matter has received little serious attention, as distinct from superficial attention, from the trade in general. This is surely evidenced by the efforts continually being made to arrange mutual trading conditions, and so on, which conditions, it must be admitted, are largely based on a somewhat casual interpretation of the words "unfair" and "costs." It appears to be the case that few of the contracting parties have any real appreciation of each other's costs. It will be found that those who have are the least inclined to enter upon any such negotiations, and it is thought that a brief survey of the matter of costs as related to unfair trading would prove of interest. Such a survey will, at least, show that relatively few instances arise which can be cited as unfair.

As it is quite insufficient to consider only the general headings of "oncost" and "labour cost," it is recognised that the sale price of any article covers the following costs, from the state of raw material to that of delivery to the user:—

1. The cost of obtaining raw material.
2. Raw material storage charges after receipt, (*a*) direct costs, (*b*) indirect costs.
3. Direct manufacturing costs, (*c*) labour cost, (*d*) machine rates, (*e*) shop oncosts.
4. Indirect manufacturing costs, (*f*) overhead charges, (*g*) salaries, (*h*) non-productive time charges.
5. Selling costs, (*i*) direct, (*j*) indirect.
6. Transport cost.
7. Profit.

At this point it is rather essential to consult a dictionary in order to clear up, if possible, the vagueness of the term "unfair," as applied commercially. Chambers's 20th Century Dictionary gives the definition as "not fair; dishonest; unequal." Of these, the first and second are no clearer to the mind than the word itself. The third, however, implies injustice, which is more readily conceivable, since certain standards of conduct exist by which any given action may be criticised, for, everything else being equal, an unfair act may be said to be one which operates in a definite unequal manner as between a person, or persons, and the perpetrator of the act. If this were not so, then every condition attaching to every commercial transaction would have the same moral value, a state of affairs which is known, from experience, not to exist. Hence, if any of the above-mentioned costs can be shown to operate *externally* in an adverse manner, in general, an unfair condition can be said to obtain.

1. *Cost of obtaining raw material.—Prima facie*, any given materials showing the same analyses should cost the same. In practice this does not hold good for a variety of reasons which are quite valid. For example, while labour may be cheap or normal, transport facilities may not be easily obtained. Geological conditions are not at all equal—and so on. These points, however, are accounted for by the fact that when firms commence to operate in any locality it is understood that they shoulder any *inherent* local disadvantages of the kind mentioned. Why else would they set up business there? So that, respecting raw material, any cost that may act adversely in the sense at present considered must be a cost quite apart from the conditions of natural environment. That is to say, it must be a cost resulting from a firm's own activities. Such costs being considered under the remaining headings, the remarks there made cover the instance of raw material. Only the question of preference enters here. For instance, if any firm possesses the monopoly of production of a basic material, and sells the material at varying prices to its mutually competing customers, then cases must arise when one or other customer suffers *undue* loss. The *due* losses he may normally suffer are referred to later. That such procedure is recognised as unfair is, of course, verified by this country's law.

2. *Raw material storage costs after receipt.*—These comprise (*a*) labour and clerking costs, which are direct charges; (*b*) direct oncost charges; and (*c*) overhead expenses (part). The latter are considered under (4) below, and (*a*) consists of wages only. Many firms consider that a labourer, or unskilled ordinary clerk, is sufficient for stores management. Others differ, and employ trained men for the purpose. The result is that the latter firms appear to be at a definite disadvantage as regards the immediate £ s. d. cost of storage. Assuming that district rates are paid by the first-mentioned firms, then the onus is definitely upon the others. It is purely their own business in such instances, and the conditions could not be interpreted externally as unfair. If, however, the reverse is the case, *i.e.*, the local rates are only paid by the second firms, then an unfair condition does exist, for, if skilled men are paid so much, it is certain that unskilled men (in the ordinary sense, and excluding those municipally employed) are paid at a lower rate. The principle of equal remuneration for equal work is much to the fore here. Also indicated, possibly, is the fallacy of employing skilled labour on work that can be performed by unskilled hands.

With regard to (*b*) the direct oncosts on storage, these comprise insurance premiums, depreciation of initial testing plant, cranes, &c., light, power, heat, stationery, &c. No unfair condition can exist here because each of these items depends entirely on the internal organisation of the firm concerned. If firms do not treat these charges in a thoroughly scientific manner, and fail to employ suitable efficient means to reduce them to a minimum, then these firms create their own disadvantage. Too often this condition of affairs is regarded as unfair, whereas such is not really the case. Surely, if a man must pay for a *faux pas* in the ordinary way, a firm is likewise responsible for its own internal misdeeds. By no stretch of the imagination can an unfair condition be discovered in this instance.

3. *Direct manufacturing costs.*—These cover labour costs, machine rates, and *shop* oncosts. The foregoing remarks apply largely in so far as labour costs are concerned. The point is whether skilled or unskilled labour ought, or ought not, to be used. For the same machine work one firm employs skilled turners, and another handymen, the point being entirely decided by individual discretion. The tendency is, however, to obviate the skilled man working on unskilled work. Competition forces this through the use of specifically designed machine tools, so that it is entirely the look-out of the firm employing skilled labour if it cannot cut its direct labour costs. This manner of looking at the matter is, most unfortunately, undoubtedly brutal to the skilled man, but, nevertheless, it is the truth, and the fact must be faced, however unpleasant.

In the fixing and costing of machine rates, &c., certain firms may find themselves in a difficulty and may grumble at unfairness. Here, again, however, the trouble can only lie with themselves. These rates are solely dependent on an efficient system of shop working, which, essentially, entails a reliable, up-to-date, costing

system. If this is non-existent, then accurate machine rates cannot be fixed, to the detriment of the firms concerned—entirely their own fault, of course. Any inequality so resulting is not caused by outside influences, and, therefore, once more no unfair condition can be said to exist.

Shop oncosts may be, however, subject to certain unfair influences. An insurance company covering a large firm's premises may be tempted to quote a lower premium (per cent.) than for a small concern. Gas and power charges do vary in certain towns, *i.e.*, generally in the centre of the town the charge per unit is less than in the suburbs, or in any external area supplied by the town or the same local company. Feu duties are known to vary largely in certain towns, and if a firm owns its own ground, then its feu duty (per unit area) will not necessarily be the same as that of its competitor situate in another part of the same town, or, of course, in another town. Rents, if grounds or premises be rented, come under the same category. In certain parts of the country old statutory charges exist especially if the site is labelled "freehold," and although these charges might be said to come under the local conditions mentioned under (1) above, since they are externally fixed by law, it is thought that they can, generally, be construed as unfair costs.

These remarks also apply to (4*f*) and need not be extended.

The question of salaries (4*g*) is generally provocative of some argument. Many argue that, if one firm pays a man £4 per week while another pays £6 to a person in the same nominal position, a condition of unfairness exists. This is ever a moot point, and one, unfortunately, upon which little definite statement may be made, for, although two men occupy precisely similar positions, it does *not* follow in practice that the men are of equal value. One may be a thoroughly technical expert, while the other may be of comparatively little use. Once more the onus is upon the individual firm concerned, for it is the natural aim of *every* man to increase his earnings. It will, in one event, pay a firm to pay a very high figure for the services of an employé who really can work, *i.e.*, even though his rate is high the quantity of his production is such as to cheapen the cost per unit. It might reasonably be said, however, that deliberate exploitation of salaried men does take place in certain instances, in which cases unfair commercial conditions cannot but exist. The exact proportion of these to the total is, however, practically impossible to ascertain.

Non-productive time charges (4*h*) are again primarily dependent upon the general internal affairs of individual management. It is up to all to keep each machine running as productively as possible, or, if it be cheaper to do so, to shut down any given machine altogether, transferring its work elsewhere. Regarding hands, the bare unvarnished truth is that no firm, especially in these days, can afford to keep on more employés than a reasonably altruistic spirit will permit. To that end, it may be said that concerns not registered on the King's Roll are unfair competitors, since those who are registered are bound to keep a certain percentage of discharged men more or less permanently employed, thus possibly giving an advantage to non-enrolled firms. This statement might be misconstrued, but no misunderstanding will arise if it is fully realised that the King's Roll is intended, apart from other objects, to provide a means of allowing men to try and recover the skill which they were bound to have lost during five years of military service. This recovery must take a long time, and thus, concerns not employing men who have lost part of their efficiency are at a definite advantage over those that do employ them.

Certain instances of labour exploitation may arise under stress of industrial conditions, &c. They have undoubtedly done so in the past, and it would be unwise to say that they are entirely absent to-day.

Local rating, again, may sometimes in slack periods operate unfairly. Thus, when a works is shut down entirely, the rating is much lighter than when it is fully running. There is no graduation, however, to allow for part of the works running while the remainder is shut down, unless it can be proved to the satisfaction of the local rating authority that a *portion* of the works may be shut down under the appellation of *unum quid*. This state of affairs is very much the exception rather than the rule, and hence an unfair condition arises.

Further, the incidence of rating in Scotland as compared with England must introduce unfair conditions. In England, the occupier only, irrespective of whether he be owner or tenant, is assessed, whereas in Scotland owner and occupier are separately assessed, the owner-occupier having to pay the double burden. While English rates are therefore higher in general, anomalous conditions must, of necessity, arise from this state of affairs, to the attendant detriment of some competitors.

5. *Direct selling costs.*—These are salesmen's salaries and expenses. With respect to salaries, the remarks above made apply. "Expenses," however, can be made to do many things. The surreptitious "back-hander" is generally an expense. No one can say that such is not the case, nor that "back-handers" do not exist. Business men, and electrical people as much as any other such, know that palm oil is sometimes very much in evidence, just as much, indeed, as tipping the waiter after dinner. True, the law is supposed to deal with the trouble, but it is unable to cope with it for very obvious reasons. Possibly this point can be interpreted as the most unfair of all. Certain firms of good standing would not deign to lower themselves to bribery, and would instantly dismiss any member of their staff found attempting it. Others, however, would not scruple to tip either in money or in kind. An unfair state of things is then painfully in evidence.

The question of selling material of foreign origin might arise here, especially if the foreign maker worked under a depreciated currency. The fact that foreign goods may be bought by all and sundry at will, however, removes the point to the realm of international arrangement and politics, besides nullifying any attempt to dub it as unfair.

Indirect selling costs (5*j*) are really covered by overhead charges, and the remarks above made will, in general, apply to them.

6. Transport costs are eternally a vexed question. Commercially, goods are transported in three ways, *viz.*, by rail, cart, or motor. The railway companies, compared to industry as a whole, are in the practical category of monopolists. Hence they must be very careful to avoid any unfairness between competing firms using their means of transport due to different charges for the same goods. Fortunately, their undertakings are so huge that it is essential to their efficient management for them to have a perfectly definite schedule of rates operating on a classified basis. Apart from the relative value of these charges to each other, of them it must be said that, in principle, for any given article, irrespective of maker, a fixed rate must be paid. In practice, this occasionally does not hold good, as many are aware, but the fault will be rarely traceable to the railway company. Knowingly or otherwise, goods are wrongly described in these instances, and as a result unfair conditions obtain. No one can deny that attempting to obtain cheap rates by deliberately misnaming the goods is unfair. Carfage and motor transport apparently offer more opportunity for unfair charging. It is only apparent, however. Compared with the railway companies, carting and motor contractors are small concerns operating on a purely competitive basis. Hence their charges must vary. It is therefore the duty of any of their customers to obtain the cheapest rate possible, covering all charges concerned. For example, it may pay to insure each consignment separately if a number of cartage or transport estimates are available. Alternatively, the working of a "floating" policy may be more economical, and so on, the matter resting almost entirely with the *buyer* of the transport. On

the basis of this article, therefore, no unfair condition arises here, since the carting and motor firms are subject to exactly the same principles of operation as other industrial concerns.

7. *Profit.*—Some state that a man, by taking a small profit, trades unfairly. Yet all are willing (apparently) to give a cheap service. Why then do grumbles arise if one is content with less profit than another? (For the moment manufacturers only are referred to.) A manufacturer to serve must, perforce, make his price suit the market, otherwise he soon runs up against "a brick wall." To this extent his position is quite different from that of the retailer. The latter, generally, is in a much easier position as regards price for the simple reason that he has to bear nothing like the responsibility of the maker for given goods. If anything goes wrong external to the retailer he merely refers back to the maker, who, while doubtless striving to prove non-responsibility, has in the end, for the sake of his sales, to bear the brunt. The position of the retailer is therefore solely a personal one, and if the manufacturer publishes a minimum list price, allowing a certain discount, the retailer has to cut his coat to suit his cloth. No two retailers can, for the reasons of environment touched upon in (1) above, have the same oncosts, and it follows that the profits must be out of phase accordingly. With that they ought to be content, since the conditions fixing the matter are quite external to themselves. It is, frankly, up to them to reduce their oncosts in a fair and intelligent manner, and so come more into line. The small man in a commercially cheaper locality must make more profit than the same man situate in a dearer part, other things being equal, of course. This condition is one inherent to general business, and depends upon the various other conditions outlined in the previous paragraphs. It is, therefore, a questionable point whether a man trades unfairly from the aspect of profit. Only in one event might such a state of affairs obtain, and that is when a competitor makes use of his home only for business premises, and this only holds, again, provided part of the house is *not* fitted out as a store or showroom. It must be remembered that many retailers reside in other parts of their business premises. Here it is so difficult to draw a line of demarcation that it is questionable if it is worth while attempting to do so, since, after all, the proportion of retailers referred to in the penultimate sentence cannot be great, although many state the contrary to be true. Facts and figures, however, are the true criterion, and no statistics of merit are, as yet, publicly available.

Taking all the important points into consideration, then, it must be admitted that few real cost conditions exist which can be interpreted as inherently unfair. Those which can be said to be so are summarised:—

A. Misuse of the principle "skilled men for skilled work."
B. Insurance premiums varying inversely as the size of premises.
C. Variation of local power, gas, land, and rating charges, &c.
D. Exploitation of salaried men and labour.
E. Bribery.
F. Misnaming goods, &c.

Of these six instances (C) is a matter of law, &c., leaving only five points which may be dealt with between firm and firm. The conditions governing unfair trading, therefore, are hardly as great as many suppose.

Electrical Imports of British Malaya.

BELOW are given the values during 1922 and 1923 of the imports of electrical and allied material into the Straits Settlements, Federated Malay States, and Non-Federated Malay States (the Straits dollar = 2s. 4d.). The countries indicated are those from which the goods were consigned, and are not necessarily the countries of manufacture.

	Straits Settlement Colony.		Federated Malay States.		Non-Federated Malay States.	
	1922.	1923.	1922.	1923.	1922.	1923.
Electrical Machinery—	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.
Total	1,304,000	1,757,000	493,000	53,000	7,000	19,000
From United Kingdom	1,004,000	1,377,000	445,000	41,000	7,000	19,000
„ India	7,000	6,000	—	—	—	—
„ Germany	45,000	65,000	2,000	2,000	—	—
„ Italy	71,000	55,000	11,000	—	—	—
„ Japan	42,000	51,000	—	—	—	—
„ United States	91,000	115,000	2,000	2,000	—	—
Engines, boilers and parts—						
Total	778,000	1,016,000	155,000	85,000	10,000	6,000
From United Kingdom	631,000	840,000	150,000	81,000	10,000	6,000
„ Germany	18,000	21,000	—	—	—	—
„ Holland	38,000	15,500	—	—	—	—
„ United States	6,000	33,000	3,000	1,000	—	—
Machinery, Other (not sewing machines)—						
Total	2,081,000	3,008,000	5,035,000	1,308,000	21,000	9,000
From United Kingdom	1,383,000	1,568,000	3,620,000	961,000	21,000	8,000
„ Australia	241,000	769,000	1,043,000	109,000	—	—
„ Denmark	79,000	10,000	2,000	—	—	—
„ Germany	45,000	77,000	9,000	7,000	—	—
„ Japan	16,000	19,000	—	—	—	—
„ United States	176,000	279,000	283,000	187,000	—	1,000
Telegraph and telephone material—						
Total	911,000	658,000	443,000	158,000	12,000	1,000
From United Kingdom	890,000	632,000	443,000	158,000	12,000	1,000
„ Sweden	10,000	1,500	—	—	—	—
Tramway and railway materials—						
Total	234,000	329,000	1,550,000	156,000	1,000	—
From United Kingdom	187,000	276,000	1,541,000	113,000	1,000	—
„ Australia	22,000	—	9,000	—	—	—
„ Italy	13,000	—	—	—	—	—
Lamps and lampware—						
Total	342,000	512,000	26,000	28,000	8,000	4,000
From United Kingdom	71,000	80,000	19,000	11,000	3,000	4,000
„ Belgium	4,000	1,000	500	—	400	—
„ Germany	92,000	173,000	—	4,000	—	—
„ Holland	15,000	46,000	1,000	3,000	—	—
„ Japan	104,000	110,000	—	—	—	—
„ United States	23,000	34,000	5,000	10,000	—	—

On Regulations.

By R. H. RAWLL.

It is not the purpose of this article to discuss the technical questions raised by the recent issue of the "I.E.E. Regulations for the Electrical Equipment of Buildings." This is being accomplished by the many excellent discussions that are taking place up and down the country, and also by the healthy ventilation of opinions in the columns of the technical Press. The writer, by reason of his work on the staff of a large electricity supply undertaking, has had the opportunity of hearing expressions of opinion from a diversity of points of view concerning the object, application, and effect of these Regulations in general; the result of this has been that he has arrived at certain conclusions, which may not be without interest to other engineers.

It seems to be generally conceded that electrical progress in this country is already hampered considerably by a surfeit of rules and regulations which have legal authority, *e.g.*, the regulations prescribed by the Electricity Commissioners, the Home Office Electricity Regulations under the Factory and Workshops Act, &c. Therefore, it appears that, if electrical engineers themselves wish voluntarily to add yet another volume to this already formidable library, good and sufficient reasons must be found for so doing.

First of all, consider for a moment what is the object of the various regulations at present in force. It will be found that they can be roughly divided into three classes, *viz.*: (1) To protect human life from danger of shock and burns; (2) to prevent the risk of fire and damage to property; and (3) to reduce the maintenance and liability to breakdown of an installation to a minimum. Now, the new I.E.E. Regulations have all the above objects in view, and are to "apply to every type of dwelling-house, business premises, public building, and factory." This seems to cover too wide a field for the same set of regulations, because the conditions prevailing in a factory are totally different to those found in the ordinary dwelling-house. It ought to be a matter of patriotic pride that this country looks after the safety of its factory workers to a greater extent than any other country in the world. But whatever individual opinion is held of the other ramifications of the Factory Acts, it is usually agreed that the electrical section thereof is, on the whole, based on sound common sense and practical experience. That, however, does not justify the proposal put forward in some quarters to the effect that the Home Office Electricity Regulations should be made to apply everywhere. Because, although several of the rulings, particularly as to the construction and type of fittings used, could with advantage be adopted for more general use in ordinary houses and those places where the Factory Acts do not apply, yet many of the precautions deemed essential in workshops are totally unnecessary in the domestic sphere. The I.E.E. Regulations, also, in many places specify very elaborate requirements, which, although desirable, are by no means necessary to "ensure satisfactory results." And on this score it is to be hoped that electrical contractors, consultants, and others will not use these Regulations as a lever to persuade their clients to install unnecessary gear on the plea that "it says so in the Regulations." It has also been pointed out that much prominence is given to masses of detail of a secondary degree of importance, whereas many items of very vital import are either omitted altogether, or else are only mentioned in such vague terms as to be worse than useless to the practical man requiring definite information on these points. It is true that draft copies of these Regulations were submitted to many individual engineers for their comments before publication, but it would have been infinitely better for all concerned to have encouraged open discussion as well by making the draft copy public, and so amending the Regulations, if necessary, before they appeared in final form. That the present set of Regulations will have to be reviewed and amended is very apparent, and the compilers would be well advised to adopt the above procedure before issuing the next edition.

What is the purpose of these Regulations? Are they intended only as a general guide on all installation matters, or are they to be rigidly adhered to in their entirety? So far no authoritative announcement has been made in this respect. The writer cannot help feeling that the real object in view is to protect the general public from the wiles of the unscrupulous and incompetent wireman. That they will be successful in achieving this is, however, decidedly problematical. The recently-formed Register of Electrical Contractors is a step also in this direction, and any means which will assist in preventing bad workmanship in wiring should have the undoubted support of all those who have the well-being of the electrical industry at heart. There is another side to this question, which is, perhaps, most apparent to the electricity supply section of the industry. The subsequent extra expense and inconvenience, which inevitably falls on the shoulders of the victim of the cheap-jack wireman, in many cases permanently prejudices the consumer as to the decided advantages of electricity, and retards electrical progress to a greater extent than many think. It has often been argued that the man who employs a person of doubtful qualifications, has only himself to blame if the resulting work is unsatisfactory. That, however, is not the point. Electrical installation work, by its very ease in execution compared with other modes of supplying energy, lends itself very easily to shoddy workmanship. The presence of bad workmanship, for example, in a gas installation would be detected almost at once, but in electrical work the fault might not manifest itself for a considerable time, and then, perhaps, with disastrous results. Electricity is a form of energy, whose nature and method of installation for the service of man cannot be compared to other more well-known forms—it is in a class of its own; and this is a fact which ought to be more widely known and appreciated. If the Regulations, even in a modified form, are to be utilised to remedy this state of affairs, who is to see that they are observed? Of course, if compliance with them is a stipulated condition in a given contract or specification, this difficulty will not arise. But in those cases where no such stipulation is made, it is obvious how ineffective, as regards raising the standard of wiring, such Regulations will be.

That there should be some recognised standard of wiring is clear. The trouble is to define that standard in all the various conditions and circumstances where electricity is called to render service. The writer knows by experience how, when a new installation is being connected to the mains, the consumer relies on the supply authority to ascertain that the work is satisfactory. This is done as far as is reasonably possible in the circumstances. But, if the premises are a private house, a complete inspection cannot be made, owing to the concealed nature of much of the work in those places; for example, connections, &c., under floorboards, where trouble is most likely to occur. The writer's own personal view is that the I.E.E. should, after due discussion before all interests involved, as suggested above, issue a set of *recommended* wiring rules of a more modest character than those recently published, and that these should be limited in their scope to buildings not of a factory character. Wiring in

factories in the majority of cases is easily inspected, being usually visible throughout its length, and furthermore, compliance with the Home Office Electricity Regulations is ensured by the activities of H.M. Electrical Inspector of Factories. The existence of such an amended set of recommended wiring rules, agreeable and satisfactory to all sections of the industry, should then be widely advertised, particularly to all potential users of electricity for domestic purposes. Supply authorities could materially assist in this propaganda work by pointing out to new consumers the desirability of placing contracts for wiring with electrical contractors only on the understanding that the work would by in accordance with these recommended rules. Then, perhaps, good would result and an evil be remedied, which is, after all, the only justification for all rules and regulations.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Novel Electric Tractor.

A somewhat novel design of electric tractor or towing machine is illustrated in fig. 1. It is known as the "electric horse" and is the invention of a Berlin engineer, who has endeavoured to meet the need for a practical and economical means of shunting railway wagons on factory sidings when the amount of work is not sufficient to justify the employment of steam or petrol locomotives, or the cost of installing and maintaining a capstan-cable haulage plant. The inventor claims that the use of horses is out of date, especially when it is possible to show an economy over their use for shunting and other short-haulage purposes.

The "electric horse" consists of a two-wheel truck, as better results are obtained from the point of view of drawbar pull and road adherence from a two-wheel than from a four-wheel tractor, owing to the weight being concentrated above a single axle. The small diameter road wheels are provided with twin solid rubber tires. The truck is driven by an electric motor rated at 3½ h.p. and an 80-volt, 40-cell battery, a heavy type being employed to withstand rough usage, weight in this application being an advantage; one half of the battery is carried forward and the other at the rear of the centrally-located motor, the accumulator trays being supported in the body of the truck by leaf springs. The capacity of the battery is sufficient for a normal eight-hour day's work on a single charge.

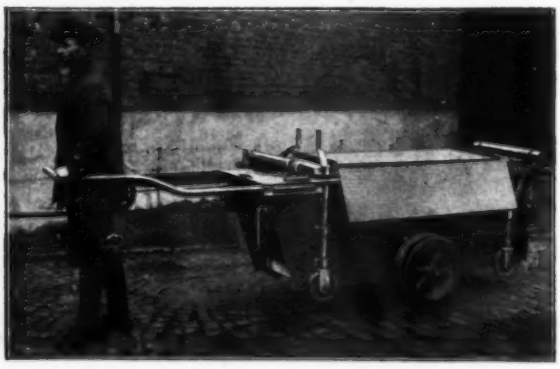


Fig. 1.—The "Electric Horse."

The motor, gearing, and axle are constructed in unit form, an arrangement which ensures constant meshing of the gears, even on rough roads. The axle is provided with a differential gear which enables the machine to be turned round in a very small space and also when in shunting operations in goods yards many rail tracks would have to be crossed, the machine can be used in a stationary position and the wagons to be shunted pulled along. With this object in view the truck is provided with a winding drum fitted with 650 ft. of cable and operated by a chain drive off one end of the axle.

It is fitted on each side with a pair of combined screw jacks and wheeled supports that prevent the truck from tilting; also, when it is to be used in a stationary position, two of the jacks are lowered to raise one of the road wheels clear of the ground, a simple clutch then enabling the cable winding drum to be brought into operation.

The dimensions of the truck are: Length 7 ft. 3 in., or including shafts about 11 ft. 9 in., width 3¾ ft. and height 3 ft., while the weight is approximately 32 cwt. The steel shafts enable the machine to be controlled by a single operator, one shaft steering the truck, and the other, by means of a hand wheel on its end, regulating the speed and the forward and backward motions.

The machine can pull a load of 25 tons on rails, or 5 tons on level roads, a total distance of 4½ miles on one charge, or half that distance with double the load and the gearing gives a maximum speed of about 2½ m.p.h.

The "electric horse" is able to push as well as pull, and is also provided with a platform top and hinged side flaps to make available a space of 4½ by 4¼ ft. for the transport of goods up to a total weight of 15 cwt. Another application is that of supplying electricity for small temporary lighting installations and for the operation of portable electric tools. Two connecting plugs are provided on the truck for such purposes.

New Electric Fires.

We continue to receive particulars of new or improved designs of electric fires, indicating that manufacturers are doing their best to induce the public to take up this hygienic and simple form of heating. Fig. 2 illustrates one of the latest designs produced by PREMIER ELECTRIC HEATERS, Ltd., Keeley Street, Watery Lane, Birmingham. The body of this handsome fire is of cast iron with a rich copper-bronze finish. There are two elements, each of 750 W, and the top one is controlled by a snap switch fitted at the base of the fire. A detachable trivet is provided, and this can be placed in the position illustrated or moved upwards to the two slots, also seen in fig. 2. The fire has a height of 14¾ in., a width of 13½ in., and it is 4 in. deep.

Fig. 2.—A New "Premier" Fire.

Among the new fires recently produced by MESSRS. BELLING AND CO., Montague Road, Upper Edmonton, N.18, is the "Hearthalite" pattern illustrated in fig. 3. This it will be observed is a combination of the reflector back system and the glowing coal effect. The bottom of the fire consists of specially-coloured glass and the concealed lamp shining through gives a very cheerful effect by lighting up the tiles of the hearth and sending its light through the imitation coal

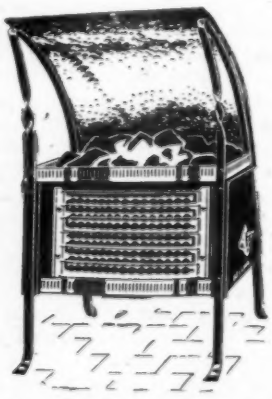


Fig. 3.—The Belling "Hearthalite" Fire.

on to the hammered copper reflector. The body of the fire is of heavy-gauge sheet brass and it can be finished in any of a variety of styles. The fire-bars are of the firm's "Multi-Parabola" type and each is loaded to 1,000 W.

The "K.W." Lampholder.

We have received from MESSRS. KIPLING & WYATT, Warremby, Redcar, Yorks., samples of the "K.W." lampholder, for which they hold a provisional patent. The main feature in the design of these is the elimination of the usual plunger springs in favour of a separate steel spring which acts upon an "S" porcelain of the usual design. This spring is entirely insulated from the current passing to the lamp, and is not subject to the heating which occasionally destroys the properties of the standard plunger springs. The metal holders are provided with a suitable earthing terminal, and, in the case of armoured work for ships, with an earthing clip. Another model is provided with an insulating cover in which the lower half acts as a shade carrier.

A New Telephone Diaphragm.

The *Electrical World* states that a telephone diaphragm made of a combination of iron filings and "Celoron," which is a fibre and bakelite compound, is being placed on the market by the DIAMOND STATE FIBRE CO., Bridgeport, Pa. The diaphragm may also be used in phonographs, loud speakers, &c. It is said to be more delicate than metal and has the peculiar property, inherent in few substances, of improvement with age.

Legal.

Stroud Electric Supply Co., Ltd., Fined.

AT the Stroud Petty Sessional Court recently, the Stroud Electric Supply Co., Ltd., was summoned for a contravention of the regulations under the Factory and Workshop Acts, as a consequence of which an employé, John Cray, received a fatal electric shock. After hearing a number of witnesses, the Chairman said that the Bench considered that the company had not adopted the best course for safeguarding the lives of its employés by completely shutting off the high-pressure apparatus. A fine of 50 guineas was imposed, with 5 guineas costs.

Electric Cable Dispute.

IN the Mayor's and City of London Court, on January 1st, before Judge Shewell Cooper, a claim was made by Mr. Charles Mickleburgh, electrical engineer and contractor, 2, Woodfield Crescent, Paddington, against the New Gutta Percha Co., Ltd., Dashwood House, New Broad Street, E.C., for £20 damages for breach of warranty. Mr. W. Banks was counsel for the plaintiff and Mr. Macdonald represented the defendants. Mr. BANKS said that his client was a contractor for the supply and fitting-up of electrical installations, and the defendants were manufacturers of electric cables. Plaintiff's claim was for damages for breach of an implied warranty under Section 14, Sub-section 1, of the Sale of Goods Act. The question in the present case was whether the electric cables supplied by the defendants to the plaintiff were fit for use in electric lighting installations. Defendants had supplied plaintiff with two kinds of cable, known as 1/18 Pernax lead-covered cable, and 1/18 Pernax cable braided and compounded. The complaint of the plaintiff was that the insulating material of the cable was not a fit and proper material for the purpose. The cable had to be pulled through steel barrel. It was not sufficiently flexible, and when, in the case of braided cable, it was pulled round corners, or, in the case of the lead sheathed cable, bent round corners, it caused a split in the cable, resulting in a short circuit. Such a thing had happened in two contracts which the plaintiff had executed when defendants' cable had been employed.

Mr. DANIA, M.I.M.E., A.I.E.E., called as a witness for the plaintiff, said he had examined the cable complained of and was of opinion that it was not suitable for use in lighting and power installations where it had to be bent. In cross-examination witness admitted that he had sent large quantities of similar cable to South America for use as telegraphic cable, or where it was required for long straight runs.

For the defence, Mr. MACDONALD said that the question for the Court to decide was whether the cable supplied was fit for the purpose. He submitted that it was and that the cause of the failure in the installations referred to was, either faulty work on the part of the plaintiff's workmen, or mechanical damage caused by carelessness. Similar cable had been supplied by defendants, in large quantities, to the Metropolitan Railway and used upon circuits at 640 volts.

Mr. E. J. LEWIS, tester in the employment of the defendants, gave evidence, and Mr. HUGH ALLEN, defendants' works manager, said he had held the position for two years and during that time no complaints had been received with regard to cable such as that in question, except from the plaintiff.

Mr. MACDONALD said that correspondence which the plaintiff had had with Smith's Electrical & Engineering Co., who had placed a contract with him, showed nothing more or less than a plan by the plaintiff to put the blame for faulty work on to materials supplied by the defendants.

Judge SHEWELL COOPER, in giving judgment, said he came to the conclusion that the cable supplied by the defendants was satisfactory in every respect, and that the defects in the installations were due to the faulty work of plaintiff's workmen. Referring to the correspondence between the plaintiff and Smith's Electrical & Engineering Co., he said it was "A very discreditable episode" and "A most disgraceful piece of deception." After reading the correspondence, he could only come to the conclusion that plaintiff's complaints were not *bona-fide* and were merely an endeavour to put the blame for the faulty workmanship of his workmen on defendants. He gave judgment on the claim for defendants, with costs.

Correspondence.

***Correspondents should forward their communications* at the earliest possible moment.** *No letter can be published unless we have the writer's name and address in our possession.*

Testing with Kenotrons.

As a manufacturer of X-ray apparatus, I was much interested in Mr. Nelson's article in your issue of December 26th, on the production of X-rays by a Kenotron valve. There is no question that X-rays can be produced by these valves, but I am of the opinion that in such cases the operator should look to his circuit rather than guard against any danger from the X-rays, otherwise his Kenotron will suffer.

Assuming the valve to be a good one, X-rays can only be produced if the anode is raised to a very high positive potential with regard to the filament, and if the circuit is correctly adjusted there need never be more than a few hundred volts. It requires several thousand volts to produce a sufficiently "penetrating" X-ray to pass through the glass bulb, and I think that your correspondent will find that when X-rays are produced the voltage drop across the Kenotron in that direction which makes the filament negative much exceeds that which the manufacturers intended, and if work is continued damage will result to the anode.

I suggest that more filament current would probably cure matters, or, if this fails, the addition of another valve in parallel.

Some valves, due to faulty exhaustion, have a sufficient residue of gas to conduct current with the filament cold, in which case X-rays will be produced after the fashion of the old type X-ray tubes; but these should be rejected.

I should be interested to hear again from Mr. Nelson if my explanation does not agree with his particular experience, in which case I shall conclude that he is using a valve of a type not yet introduced into X-ray work.

A. C. Gunstone,
The "Solus" Electrical Co.

London, *December 30th*, 1924.

Tidal Power.

The ancient *Forge-Catalane* had no sins, and Romilly's estimate of a 42 per cent. efficiency was probably too low. What Mr. Underwood says about Hero of Alexandria is not to the point, and I make him a present of the German wind-power machine, which is not what Dr. Haldane referred to.

A tidal dam-air-compressor-turbine combination is the worst on record, as Mr. Underwood and others will realise when they have had time to think about it; and, if the American journals he mentions bear out his figures, I have no hesitation in declaring the reports which I have not seen to be wrong.

Wm. H. Massey.

Twyford, *January 3rd*, 1925.

Carbonising Coal with Electrical Heat.

There is no doubt that the carbonisation of coal by electrical heat can be carried out very efficiently, and in a most satisfactory manner.

The late Mr. C. Orme Bastian carried out a very large number of experiments in this direction, with extremely good results.

London, *January 3rd*, 1925. **Bastian & Allen.**

Sea-going Electricians.

With reference to "Turbo's" inquiry *re* the above, having been to sea as an electrican myself, I am able to give the following particulars:—

1.—Procedure *re* employment.—It is first of all necessary to obtain an interview with the superintendent engineer of the line.

2.—Companies carrying electricians.—Nearly all the first-class lines, namely, Cunard, White Star, R.M.S.P. Co., Union Castle, Glen Line, and P. & O. I sailed with the last-named company.

3.—Wages and conditions.—It is just about a year since I left the sea, but wages are at present, I think, from about £14 to £18 or £19 per month; out of this one has to provide

uniform and, in some cases, mess kit, as an electrician is rated as an officer. If I were "Turbo," I should not pay too much attention to the "officer" part of the job, as there is quite a lot of dirty work to be done "down below," often in a temperature (in the tropics) of 120 deg. F.; sometimes many hours are worked during a day, and sometimes only a few—there are not any "week-ends" at sea, however. Still, taking the good with the bad, the life is quite good—for a time. The greatest bugbear of the job, in my opinion, is that the chief engineer of the ship, who is, of course, a mechanical man, is boss of the electrical side as well, and in many cases his knowledge of electrical gear is confined to that which he obtains through his B.O.T. exam.; this to an electrical man is often very annoying, and was one of the reasons why I left the sea.

Accommodation is quite good, a single-berth cabin often being provided, or, at the worst, one shares a cabin with another fellow, either an electrician on the larger ships or a junior engineer on the smaller.

"Once a Batti-Wallah."

January 4th, 1925.

Reviews.

Relativity and Common Sense. By F. M. DENTON. Pp. xviii+279; figs. 82. Cambridge University Press. Price 10s. 6d. net.

This is an ambiguous title, because to most people relativity is the very antithesis of common-sense; and it is idle to pretend that the two can be reconciled without doing violence to one of them. So it is to be hoped that no one will think that this book will bring the science of relativity within the compass of common-sense in the ordinary meaning of that expression. However, common-sense is itself a relative term. The common-sense of scientific men is very different from that of laymen; and there are none of our readers but would treat as common-sense many matters relating to electricity, which, to less-favoured mortals, would seem very far removed from it. Yet there is much to be said for the title.

The whole of physical science has arisen out of the attempt to reconcile the facts of observation with common-sense, and it is a little disconcerting to find, in relativity, its latest development, the very peak and blossom of all that endeavour; this attempt has led to a theory which defies, not only the common-sense with which it started, but any sort of sense intelligible to ordinary men.

Ordinary people, when they see two bodies collide, assume that forces act upon both bodies; and if you ask why, the conclusion must be, that they argue from their experience of what happens when their own body is one of the bodies in question. It is now very old-fashioned to be talking about forces in this way. In the light of relativity the appearance of what has been called force is evidence of a kink or hummock in a four-dimensioned continuum, in which time is manipulated in the same way as the other three. This continuum with its warps and kinks is quite inconceivable—it is not merely hard to understand, but impossible to conceive; all that anyone can do is to envisage aspects of it, by analogies derived from our experience of time and space such as we think in. So the logical development of common-sense has led to its final and complete negation.

The author does not put it in quite this way, but he, nevertheless, makes it very clear. If the practical man complains of this as the lamest of all possible conclusions, it is probably because he labours under a delusion. He probably has it firmly fixed in his mind, as an article of creed, that any scientifically observed measurements, carefully made and vouched for in the great laboratories of the world, are reconcilable with each other and with the properties of space and time with which the workings of his own mind have made him familiar. This is his mistake. The scientific men of the world have united their best endeavours to do just this very thing he takes for granted can be done: and this relativity is the best they can make of it.

If any reader doubts the parlous state of affairs, he may be safely advised to acquaint himself with the contents of the book before us. Mr. Denton will take him gently by the hand and lead him by easy routes, and step by step, to inconceivable conclusions, from which there is no escape. Indeed, he is never likely to find a better guide to the labyrinth in which scientific men involve themselves when they try and make the facts of nature square with common-sense.

The Electron. By R. A. MILLIKAN. Pp. xiv+293; figs. 42. University of Chicago Press. Price $1.75.

This book is the second edition of one which was first published in 1917. Its object is to set out the evidence upon which the idea of electricity, as fluid, has been superseded by the idea of electricity, as atomic. For many purposes of electrical engineering the former idea is just as useful as the latter, covering, as it does, all practical applications; and some electrical engineers may not yet have thought it worth while to acquaint themselves with the reasons for discarding it. These will find the evidence very concisely marshalled in this book. Chapter iv, on the general proof of the atomic nature of electricity, is a happy combination of clearness and condensation, the perusal of which will save the reader a lot of trouble, assuming he desires to acquaint himself with the facts. The changes introduced in the second edition are almost all in the nature of addition, and there are but few passages in the first edition that have been omitted. For the most part the alterations have been made necessary by recent discovery and experimental research.

The author has a great reputation for skill in the conduct of experimental research, and his considered account of the results obtained has a particular interest for this reason. The most significant properties of the electron are examined and described with the care which only characterises one devoted to his subject. These properties are then considered in their relations with the two crucial problems of modern physics, that is to say, atomic structure and electromagnetic radiation. As an experimenter, the author does not shun discussion of exact quantitative experiments, and this is to the advantage of the book, because the whole of the new developments in physics are based on quantitative results of exact experiment.

The general flow of the discussion is continued throughout the argument, uninterrupted by detailed analyses, the mathematical proof being given in appendices, nine in number. Many persons to whom the subject matter in the body of the book is already fairly familiar will find the appendices useful, because the mathematical treatment is simple and neat. It is not always realised how much trouble the reader may be saved by making the mathematics necessary to a subject as simple and neat as possible; nor, indeed, is it often realised how much trouble an author must take to give them these qualities in the highest degree. It may be safely asserted that, whatever trouble may have been required, Mr. Millikan has not shirked it. The book is interesting and easy to read.

Handbook on Ball and Roller Bearings. By A. W. MACAULEY, A.M.I.Mech.E. Pp. xx+378; figs. 313. London: Sir Isaac Pitman & Sons, Ltd. Price 12s. 6d. net.

There are some branches of engineering construction and design of which the average electrical and mechanical engineer has a very limited practical knowledge, and about which he is compelled to a very large extent to rely upon expert opinion. This handbook deals with one of those special branches, and the author, who has unfortunately died since its publication, was technical manager in the service of the Skefko Ball Bearing Co. He was enabled, by virtue of his position, to avail himself in the preparation of his book of the results of research carried out by the S.K.F. Co. in its laboratories in different parts of the world, and of the practical experience obtained through its branches in most of the important cities of the world.

To many the application of ball and roller bearings appears to be a fairly simple problem, but it is only after many years of experimenting by engineers, toolmakers, and metallurgists that ball and roller bearings, which possess many advantages over the solid type of bearing, have passed the experimental stage.

Although so much attention has been paid to the improvement of ball and roller bearings, they must be used with great care, and only after careful consideration of every possible factor.

The book is arranged in two parts; the first part deals with the theoretical aspect of the subject. Plain and ball bearings are compared, and the various developments in ball bearings concisely set out. The efficiency of ball bearings is thoroughly considered, and the modern methods of testing them are described.

Representative bearings are referred to, and the methods of manufacturing the various parts of bearings are fully described. During the early developments many of the processes were kept secret, but complete publicity has been given for some years by several of the leading manufacturers.

Different types of roller bearings, together with the subject of lubrication, are considered in the last chapter of this portion of the book.

The second part of the book deals with the application and maintenance of bearings, and will be found of greatest interest to the general engineer. Practically every class of bearings is referred to, and their application to the different branches of work, such as electrical, woodworking, general engineering and textile, are clearly shown by means of illustrations, and suitably described in the text. The book ends with a large number of tables, data, and appendices.

The book was written with the object of enabling manufacturers to improve their productions, draughtsmen to design machines suitable for such bearings, machinists to fit them in the most suitable manner, and users to intelligently use and maintain them. The author can be said to have admirably succeeded in his object, and he has undoubtedly produced a book which can be thoroughly recommended to all those desiring information on this important and rather neglected subject.

E. P.

Business Notes.

The "Electrical Review" Index.—The Index for the last half-yearly volume of the ELECTRICAL REVIEW (July to December, 1924) will shortly be published. Copies will be forwarded post free to those requiring them for binding or for reference purposes, if they will make application to the Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, E.C.4.

Company Liquidations.—FOGDENS ELECTRIC CO., LTD.—Winding up voluntarily. Liquidator, Mr. C. F. Farmery, 6, South Hill Park Gardens, Hampstead, N.W.3. A meeting of creditors was called for January 7th. Particulars of claims to be sent to the liquidator by January 31st.

NORWOOD WHOLESALE FITTINGS SUPPLY CO., LTD., 56a, Walworth Road, S.E., late 71, High Street, South Norwood.—A meeting of creditors was held on December 31st, when the chair was occupied by Mr. A. J. P. Coleman, accountant, who had been appointed to act as the liquidator in the voluntary liquidation of the company. The chairman said that the assets would be insufficient to meet the debenture holders' claim, and consequently there would be nothing whatever for the creditors. A statement of affairs which had been prepared disclosed gross liabilities of £3,391, made up as follows:—Share capital issued, £400; due on debenture, £190; preferential claims, £98; bank overdraft, £70; and unsecured trade creditors, £2,633. The assets totalled £346, or a deficiency of £3,045. The nominal capital of the company was £1,000, and shares to the value of £400 had been issued. The debenture was for £250, and it bore interest at the rate of 7½ per cent. per annum. A sum of £60 had been repaid to the debenture holder, who was therefore a creditor for £190. There was a sum of approximately £90 due to persons who had sent money to the company for goods which they had not received. The chairman considered that the company was insolvent when the debenture was issued; a receiver was appointed three days after. Some portion of the debenture money, amounting to about £60, was then in the hands of the company, and that was taken in part re-payment of the debenture holder's claim. The balance of the £250 raised on the debenture was utilised in making cash purchases and in paying wages and other items. The books of the company had been properly kept and all payments could be traced. The present directors were only appointed about December 2nd last.

In answer to questions, the chairman stated that the company was formed last May, and he thought that there had been mismanagement. One of the directors received about £6 a week, and the second, who was an employé and knew little about the concern, had received £3 10s. a week. The company did not appear to have bought well.

Another creditor inquired if the company had anything to do with a concern called the Elephant Electric Emporium, and the chairman said that it was really the Norwood Wholesale Fittings Supply Co., Ltd. The directors of the company asked him whether, under the Business Names Registration Act, they could trade as the Elephant Electric Emporium, and he advised them that they could only carry on business in the name of the company.

Dissatisfaction was expressed at the position disclosed, and several creditors stated that they thought it was a case for a thorough investigation. Mr. Latham proposed a resolution to the effect that the trading of the company called for inquiry, and that it was desirable for a compulsory winding-up to take place. The resolution was duly seconded and carried unanimously, and it was further decided that the creditors generally should support the principal creditors in filing a petition.

The following are among the creditors:—

	£
M. Papier	78
New London Electron Co.	43
Schraum & Co.	34
Kenson & Co.	22
Premier Telephone Co.	45
New Eccles Rubber Co.	42
A. E. Norton	24
Mullard Valve Co.	83
Dundas Fox	43
Fuller's United Electric Works, Ltd.	32
B. A. G. Co.	106
— Coleman	42
Borough of Southwark	37
Allan Cleaver & Co.	87
Foster Engineering Co.	30
Toreado Co.	31
A. Barnett	21
Languard & Co.	30
Merchants & Agencies	118
X. L. O. Co	25
Marconiphone Co., Ltd.	82
H. Clarke & Co.	32
R. A. Rothermel	55
Terrill & Co.	36
Enstone & Lilienfeld	22
G. Bowerman	613
Corre & Co.	29
Edison Swan Electric Co., Ltd.	43
— Dacier	21
Spreckley & Co.	77
C. T. Brock & Co.	30
— Frost	20
N. Behr	58
Sorbo Rubber Co.	27
ELECTRICAL REVIEW	40

ELECTRICAL CONTRACTS & MAINTENANCE COMPANY, LTD., Sanctuary House, Westminster.—The compulsory winding up order against this company was made on a creditor's petition on October 14th, and on the 2nd inst. the statutory first meetings of the creditors and contributories were held at 33, Carey Street, W.C. The statement of affairs filed in the proceedings showed total liabilities of £5,732, of which £4,329 is scheduled as unsecured, and assets expected to produce £2,240, less preference claims £478 and loans on debenture bonds £924. The total deficiency as regards shareholders is £6,292.

Mr. E. T. A. PHILLIPS, the Assistant Receiver, presided, and reported that the company was incorporated in February, 1919, with a nominal capital of £3,000, divided into shares of £1 each and was formed to acquire and carry on the business of the Private Wire & Telephone Installation, Ltd., and that of the Electrical Engineering & Maintenance Co., and to manufacture, install, and deal in all articles connected with electricity. The issued capital was £3,000, represented by 1,609 shares allotted as fully paid in part satisfaction of the purchase consideration for the two businesses and by 1,391 shares issued for cash. In 1916 the company secured a contract from the War Office and acquired for £6,000 a freehold property at Willesden, where work in connection with it was conducted. A loan of £10,000 was obtained from the bank to enable the company to complete the purchase of the factory and equip it. A debenture was handed to the bank to secure that loan. The factory was eventually sold, together with a book debt for £1,000, for £15,000, of which £1,646 was still unpaid at the date of the winding up order. That book debt was returned as of no value. On May 30th last the directors created a debenture for £910, charging all the company's undertaking and assets as security for money advanced, &c. Last year various creditors obtained judgments against the company and in consequence of an execution being attempted in August the holder of the debenture appointed Mr. C. H. Barham, C.A., College Hill Chambers, E.C., as receiver. He had recently accepted an offer for the sale of the business and if the transaction were carried to a satisfactory conclusion a small sum might become available in the liquidation for distribution. Before the date of the winding up order, however, the leases of the company's premises had been deposited with a creditor in whose favour a charge was created by the company, but it was not registered. The creditor now declined to part with possession of the leases until security had been handed to him for the amount due from the company plus costs, and it might be necessary to apply to the Court to determine that matter. The creditor in question did, however, hold the guarantee of a director in respect of the sum due. The failure of the company was attributed to depression in the electrical trade during the last few years and also he presumed very severe competition and to the adverse result of an action. In the opinion of the Official Receiver the company possessed insufficient working capital and that fact very considerably contributed to its failure.

It was decided to leave the liquidation in the hands of the Official Receiver.

Appended is a list of the chief creditors:—

	£
British Insulated & Helsby Cables, Ltd.	131
British Thomson-Houston Co., Ltd.	24
Brown, S. G., Ltd.	35
Beldam Tyre Co. (1920), Ltd.	29
Biggleston, H. M., & Sons, Ltd.	180
Continental Auto-Telep Co., Ltd.	102
Ever-Ready Co. (Gt. Britain), Ltd.	89
Ericsson Mfg. Co., Ltd.	403
Falk, Stadelmann & Co., Ltd.	22
Foster & Dicksee, Ltd.	73
General Electric Co., Ltd.	221
Hogan & Wardrop	41
Henley's, W. T., Telegraph Works Co., Ltd.	83
Holliday & Greenwood, Ltd.	32
International Electric Co., Ltd.	67
Kelly's Directories, Ltd.	62
London Elec. Wire Co., Ltd.	31
Lelios Lamp Co., Ltd.	57
Mackintosh Cable Co., Ltd.	49
Nettlefold & Sons, Ltd.	59
N.E.C.T.A., Ltd.	22
Perrins, Ltd.	26
Relay Auto. Telephone Co., Ltd.	230
Reliance Electrical Wire Co., Ltd.	61
Ruston & Hornsby, Ltd.	179
Rhodes Motors, Ltd.	23
Sells, Ltd.	116
Sells, Ltd.	193
Synchronome Co., Ltd.	24
Siemens Bros. & Co., Ltd.	116
Sax, Julius, & Co., Ltd.	23
Trade Telephone Works	30
Western Electric Co., Ltd.	403
Carnaby, Harrower, Barham & Co.	34
Pref. Creditors	1,030

BOVING ENGINEERING WORKS, LTD.—A meeting of creditors is called for January 19th at the offices of Messrs. G. A. Touche & Co., Basildon House, E.C. Particulars of claims to the liquidator, Mr. D. M. Touche, Basildon House, E.C., by March 8th.

Private Arrangements.—C. G. FOX, trading as Kingston Radio Supplies, 43, George Street, Hull.—The creditors interested herein were called together on January 1st at the offices of Messrs. Scott & Wheatley, C.A., 10, Lowgate, Hull, when a statement of affairs was submitted which disclosed liabilities of £1,739, all due to unsecured creditors. The assets totalled £621, from which had to be deducted £22 for preferential claims, leaving net assets of £599, or a deficiency of £1,140. It was decided that the debtor should execute a deed of assignment for the benefit of his creditors to Mr. Charles H. Baker, of Standard Buildings, City Square, Leeds, with a committee of inspection consisting of Messrs. G. Jackson, Leeds, Empire Radio Co., Birmingham, and the Hallamshire Electric Co., Ltd., Sheffield. The following are creditors:—

	£
G. Jackson	481
Empire Radio Co.	239
Gilbert & Co.	161
Hallamshire Electric Co., Ltd.	98
H. Clark & Co. (Manchester), Ltd.	96
Paragon Rubber Mfg. Co., Ltd.	75
Engineering Supplies, Ltd.	67
S. D. H. Manufacturing Co.	53
Eastern Morning and Hull News Co., Ltd.	45
Lisennir Wireless Co.	40
Thompson Brown Bros., Ltd.	40
British Electric & Manufacturing Co.	36
London Radio Stores	34
Hull Daily Mail	29
Wakeling & Wray	25
General Radio Co.	20
Barclay's Radio Stores	22
Tele-Radio Co.	22

E. E. STOCKWELL, trading as E. & E. Stockwell, electrical contractors, 164a, Pentonville Road, N.—The adjourned meeting of the creditors in this matter was held recently. The first meeting was adjourned in order that the debtor might

obtain a satisfactory guarantee for a composition of 5s. in the £. Mr. Bacon, representing the largest creditors, said that he had examined the books and found that the trade creditors stood at £915 instead of £895. The assets totalled £290, or a deficiency of £625. The business had not been a paying concern, and at June 30th last the bank account was overdrawn to the extent of £24. Mr. Bacon added that the debtor had not been able to find the guarantee, but hoped in 14 days to be able to find sufficient cash to pay the composition. The meeting was again adjourned.

Dissolution of Partnership.—RADIO PATENTS, dealers in wireless components, 22 and 22a, Regent Street, W.—Mr. H. C. Meyer and Mr. R. J. W. Heath have dissolved partnership. Mr. Heath will continue the business.

Trade Announcements.—MR. J. E. LESTER (late J. E. Lester & Folwell, Ltd.) has terminated his engagement with the Terminus Garage, and has commenced business on his own account as an electrical engineer and contractor at 62, London Road, Leicester. He desires to receive trade catalogues.

The telephone number of Messrs. DAWSON & EVANS, consulting engineers, is now "Franklin 6049."

Mr. J. F. POYNTER announces that he has completed arrangements for the future of the Maxim Works and the introduction of the "Maxim" valve. His new firm, Messrs. Poynter, Griffiths & Co., Ltd., has taken the business over as from November 1st, 1924, and he is now assured of sufficient capital to secure its development.

Messrs. ROWLAND-ROUSE, LTD., 3 and 5, Bouverie Place, Folkestone, have opened a wireless department.

Mr. H. FEATHER, electrical engineer, of Folkestone, has removed to larger premises at 2c, Bournemouth Gardens.

Mr. J. DYSON, mechanical and electrical engineer, has removed his showroom to Picture House Chambers, Thornton Road, Bradford, where he has greatly increased accommodation.

Catalogues and Lists.—MESSRS. C. J. THURSFIELD & CO., LTD., Clement Street Parade, Birmingham.—Catalogue No. 14, containing numerous illustrations of ornamental lighting fittings, including bowls, shades, electroliers, brackets, standards, &c.

MESSRS. BELLING & CO., Derby Road Works, Montague Road, Upper Edmonton, N.18.—A leaflet illustrating two new fires. Priced.

MESSRS. L. MCMICHAEL, LTD., Hastings House, Norfolk Street, Strand, W.C.2.—A circular letter dealing with the company's radio apparatus business.

MESSRS. BOVING & CO., LTD., 56, Kingsway, W.C.2.—Two illustrated bilingual catalogues of the company's hydro-electric equipment, one in English and French and the other in Spanish and Portuguese.

MESSRS. W. & T. AVERY, LTD., Soho Foundry, Birmingham.—Catalogue No. 4,000 illustrating and describing weighing apparatus of a number of patterns.

THE SIEMENS & ENGLISH ELECTRIC LAMP CO., LTD., 38-39, Upper Thames Street, E.C.4.—Price Lists No. 72 and 73, dealing respectively with Cornelian glassware bowls and shades, and decorative glass shades for gasfilled lamps. Also the company's January price list and an illustrated leaflet advertising spun metal canopies for lighting glassware.

Calendars and Diaries.—We have received from Mr. E. A. Graham and his staff greeting cards for the New Year. Each of these is provided with an illustration introducing an "Amplion" loud speaker in use.

The LIVERPOOL ELECTRIC CABLE CO., LTD.'s calendar for the New Year bears a finely-coloured picture of a launch on the Mersey.

MESSRS. LINDSAY & WARD (Newcastle-on-Tyne) have sent us a large calendar with monthly slips and illustrations of the products of manufacturers for which they are agents.

In inviting us to "travel by road," the calendar of the LANCASHIRE UNITED TRAMWAYS, LTD., depicts days that are gone—introducing a four-in-hand coach and deep snow.

A large-figured date block and illustrations of their products are the features of a calendar received from MESSRS. J. SHAW, SON & GREENHALGH, LTD., of Huddersfield.

A very neat calendar has been issued by the ENGLISH ELECTRIC CO., LTD. This has a simple grey background with little lettering and a block of legible date slips.

MESSRS. RUSTON & HORNSBY, LTD., of Lincoln, have issued a wall calendar with large monthly sheets, each bearing a half-tone picture of plant manufactured by them.

The calendar of the DAVENPORT ENGINEERING CO., LTD., again depicts some of the company's cooling towers, and has a block of plain-figured daily slips.

MESSRS. WALKER VEHICLES, LTD., have sent us a profile model of one of their electric vans, the cargo of which is a calendar.

MESSRS. W. H. SUGDEN & CO., LTD., of Glenny Road, Barking, have issued a serviceable wall calendar with monthly sheets having daily engagement spaces.

The CITY ELECTRICAL CO., LTD., of Emerald Street, Theobald's Road, London, W.C.1, has prepared a wall calendar with a picture in colour of a type of beauty of the Southern shores.

The ELECTRICAL POWER ENGINEERS' ASSOCIATION has issued a calendar which shows also the N.J.B. schedule of salaries and cost-of-living variation table, very conveniently for reference.

THE KEY ENGINEERING CO., LTD., has sent us a small celloid slip upon which are printed a calendar for 1925 and, upon the edges, metric and British scales.

The calendar published by MESSRS. ROYCE, LTD., consists of monthly sheets, each of which bears an illustration of the company's electric cranes, transporters, generators, and other products.

Japanese Electrical Imports.—*Commerce Reports* states that although the import business of Japan is generally quiet, there are good prospects of substantial imports of electrical equipment.

Brazilian Electrical Imports.—Imports of electrical equipment into Brazil during September, 1924, amounted to 56 metric tons. According to the manifests of incoming vessels during the month, 153 metric tons was imported from the United States; 94 metric tons from Germany; 20 metric tons from Italy; 15 metric tons from Great Britain; while the remaining 24 metric tons was imported from all other countries.—*Commerce Reports.*

Book Notices.—Technologic Paper No. 265 of the United States Bureau of Standards, "Theory and Performance of Rectifiers." (63 pp., illustrated.) Washington: Government Printing Office. Price 20 cents.—The purpose of the recorded investigations was to determine the performances of various types of rectifiers used for battery charging, and to present the theoretical principles on the basis of which their performance may be explained. The rectifiers studied included an aluminium and a tantalum electrolytic rectifiers, two thermionic rectifiers, and five of the magnetic vibrating type.

"The *Mechanical World* Year Book, 1925." (Pp. 170+36 and diary.) London: Emmott & Co., Ltd. Price 1s. 6d. net.—This is the 38th year of issue of this useful handbook, and, apart from the general bringing up-to-date, a new section appears dealing with surface condensers for steam turbines. The re-written portions include the sections relating to internal combustion engines and gas producers. Additional tables are given in the chapters dealing with structural iron and steel work.

"*Wireless Trader* Year Book and Diary." London: Trader Publishing Co., Ltd. Price 5s. 6d. post free and 7s. 6d. overseas.—This is a first edition and, useful as the diary section itself will be found, the most important to the average reader will be the four directory sections in variously coloured paper. They contain lists of trade and professional addresses, goods supplied and services rendered, a territorial list of factors, and proprietary names, and the difficulty of keeping such things up-to-date is shown by the fact that provision has already been made for the publication of supplementary lists; one such list is, indeed, incorporated in the year book. The editorial section has been specially compiled and gives general, trade, and broadcasting information, and technical data.

"Journal of Scientific Instruments." Vol. II, December, 1924, No. 3. Pp. xii + 112; 68 figs. London: Cambridge University Press. Price 2s. 6d. net.—This is a special enlarged number, 48 pages being entirely devoted to an illustrated description of the new apparatus shown at the Physical Society's exhibition.

"Electric Wiring," by A. A. Schuhler. Pp. vii + 361; figs. 305. London: McGraw Hill Publishing Co., Ltd. Price 12s. 6d.

Brazilian Electrical Contracts. — According to a report from Rio de Janeiro, several large electrical contracts have been held over until this year chiefly owing to unsettled conditions. In many electrical lines where American competition was impossible owing to low German prices, the latter have been increased from 10 per cent. to 15 per cent., while American prices have remained fairly stationary.

Machinery Required in Chile.—In contrast to the northern and central regions of Chile, which are suffering severely from the effects of drought, the southern districts are enjoying satisfactory harvests, with a consequent demand for agricultural implements, particularly hay and harvesting machinery, motor trucks and tractors. There is also an insistent inquiry for electrical equipment for both power and mining purposes. Considerable activity in building circles is also reported.

Owing to German prices in Chile for some lines of electrical equipment having been substantially advanced, German imports have fallen off. This has given an opportunity for the introduction of additional American equipment; so far importers of British goods have taken little advantage of the opportunity offered.—*Reuter's Trade Service.*

The German Metal Industry.—According to a report of the Central Union of the German Metal Rolling and Smelting Industry of Cologne, the satisfactory degree of employment at the works continues. Manufacturers of metal goods and the clock industry have given further large orders and the motor vehicle and radio telegraphy exhibitions had an enlivening effect. Anxiety, however, is felt as to whether the manufacturing industries will find themselves generally in a position to take delivery of the large quantities ordered and make prompt payments. Prices are still quite unsatisfactory, in many cases, indeed, more so than during the previous month owing to the much higher raw metal prices. Many works are not making any attempt to obtain foreign orders as the prices do not even cover the cost of production.—*Reuter's Trade Service* (Berlin).

Egyptian Government Contracts.—The Cairo correspondent of *The Times Trade and Engineering Supplement* says that a number of large contracts have been placed abroad by the Government during the year, and the absence of any British tender for many contracts such as the new station buildings at Alexandria and the Suez harbour work has been very noticeable. Local Swiss firms acting for German and French principals have been successful in obtaining large Government orders for a hydro-electric installation in the Fayum and for several light and power installations in the provinces; for the greater portion of the annual requirements of the Egyptian State Railways and Telegraphs contracts were placed with foreign firms. Many of these are of considerable value. Recent orders for locomotives have all been obtained by Italian firms, but it is to be hoped that United Kingdom manufacturers will make special efforts to secure a fair share of the considerable contracts which, it is anticipated, the Railways Administration will soon be placing.

German Working Hours.—A Bill is being drafted by the German Government providing for the institution of an eight-hour day, with a number of reservations, consideration being paid to "economic requirements in individual industrial branches."

Radio Trade on the South Coast.—Until about 12 months ago the radio apparatus trade in the South of England was exceedingly poor, due largely to the inability to receive the lower wavelength stations without the constant interruption caused by the close proximity to the ships in the Channel and the coast stations of Newhaven and Dieppe. With the opening of the Chelmsford high-power station, however, operating on a higher wavelength, the perfect reception of concerts was made possible, resulting in a marked increase in the radio trade. Business has continued to improve during the past few months, and at the present time is satisfactory. A steady demand exists for complete sets, whilst the call for component parts by home constructors was so heavy during the past month as to entail a shortage locally of many of the well-known proprietary lines.

Social Events.—On January 3rd the staff of Messrs. Francis Polden & Co., Ltd., held its annual dinner at Slater's Restaurant, Cannon Street. After the dinner, Mr. R. Plummer proposed the health of "The Chairman and Company," to which Mr. F. C. Polden responded. In his reply, and also in proposing the toast of "The Indoor and Outdoor Staffs," Mr. Polden said that the company had experienced a prosperous year and was commencing the New Year with many important orders in hand. It was proposed to run a stand at the forthcoming Ideal Home Exhibition, at which appliances for which the company was agent would be displayed.

Messrs. P. Wood and T. Coppard responded to the toast on behalf of the staff. Mr. A. C. Hill proposed the health of "The Ladies and Visitors," and Mr. J. R. Hill replied. Mr. R. Bruce thanked the Social Committee for the excellence of the arrangements, and Mr. E. D. Gill (secretary) replied in a witty speech. The guests then adjourned to an upper room, where they were well entertained by the "Merry Dominoes" Concert Party.

The first dance of the staff of Vickers and International Combustion Engineering, Ltd., was held at Caxton Hall, Westminster, on January 3rd, about 130 being present. The company included Mr. George C. Usher, general manager, and Mr. David Wilson, sales manager. Mr. H. C. Mount acted as M.C. Another dance will take place shortly.

Russian Notes.—*Electric Traction.*—The Central Electrical Trust is reported to have orders in hand for the construction of 35 tramcars for the Baku tramways and of supplementary converters for new sub-staticns for the same tramway. The Trust is also building 30 new cars for the Rostoff tramway and 25 for Kieff, and a contract for 10 cars is expected to be received from Sumar. In addition, 350 motors of a new type are being constructed for 175 cars of the Moscow tramways, while 30 cars for the same city are undergoing reconstruction. The work of equipping the Baku-Sabunchi-Surakani electric railway is proceeding, and the line is expected to be opened in November next.

Gasfilled Lamps.—It is estimated that the number of gas-filled lamps in use in Russia amounts to 3,000,000, the useful life of which is put at about 800 hours each, and from 1,500,000 to 2,000,000 lamps are discarded every year. The Kydinoff factory of the Central Electrical Trust has devised a method of restoring burnt-out lamps, and it is beginning to accept lamps for the purpose of renewal.

New Generating Stations.—Among the orders recently received by the Central Electrical Trust are mentioned one for the construction of a station of 2,000 kW in the town of Leninkana, Armenia, which is to be increased to 4,000 kW, this being the second works in Armenia, the first being that at Erivan. In Georgia another station of 2,000 kW is to be erected by the Trust on the River Abash, near the town of Novo-Cenaki. Some 15 small installations of an average capacity of 150 kW are being carried out by the Tiflis branch of the Trust, while similar work is going on in the districts of Rostoff, the Kuban, and the Donetz.

The Volkhov Station.—It is stated that unless unforeseen circumstances arise it will be possible to transmit energy from this large station to Leningrad at the end of 1925 or the beginning of 1926, when at least one half of the plant capacity will be available. The special committee of the North-Western Industrial Bureau has prepared a list of those undertakings in Leningrad which in the first place will have to change over to energy supplied from the station. The supply of energy from the latter will be insufficient for all the requirements, and it will therefore be necessary either to re-equip the Leningrad stations or proceed to erect a hydro-electric works on the Sviri.

Future Electrical Works.—At the request of the State Planning Commission, Mr. S. A. Kukelya has just placed before the Electric Planning Commission a report concerning the electrification schemes in the next few years. The report states that the financial situation does not permit of the development of electrical construction equally throughout Russia, and it is therefore necessary to concentrate the allotted expenditure on work in the most important parts. So far construction has been centred around Moscow and Leningrad, and it would be possible to relieve the Budget to a great extent if the supply business in these two districts were combined in one single trust, with credits granted by the Electrical Bank. It would also be possible for the same purpose for the bank to issue bonds (obligations) among the customers for energy in the region of Moscow and Leningrad. Coming to consider the question of still further progress, the report states that the next problems to be attacked refer to the construction of a steam power station in the vicinity of the Dnieper, the establishment of a high-pressure network in the Ural, the development of the high-pressure network in connection with the Nischni-Novgorod and the Shteroff stations, the interconnection of these two stations and the erection of a station in the southern basin of Moscow. Next to these big works the report considers it essential to support the local stations undertaken by companies formed of local consumers.

The Moscow United Cable Works.—The difficulties under which the United Cable Works in Moscow are being carried on are narrated at some length by a correspondent in the columns of a Moscow newspaper. The union is composed of the Russkabel (the former Podobedoff) and the Baskakoff Cable Works (formerly Alekeeff & Co.), which were amalgamated in April, 1923. At the beginning of the last fiscal year the situation of the works became critical owing to the scarcity of orders. Now, however, the works have an abundance of orders; the lighting and power cable department is loaded to the extent of 95 per cent. of its productive capacity, the wire department to 100 per cent., the flexible cord department to 100 per cent., and the dynamo-winding department to 100 per cent., but the telephone cable department has an activity of only 5 per cent. of its capacity. The labour cost is stated to be very high. The Central Paper Trust is now manufacturing cable paper, which was formerly imported from Germany; and the Metal Works has succeeded in producing armouring which was also obtained from abroad. The difficulties lie in the lack of adequate funds, owing to which the cable works do not receive materials in time, and are eventually compelled to pay up to 200 to 300 per cent. of the value of the materials when actually received, while at the same time it is asserted that the workmen are overpaid for their labour, and the general process of production is disorganised.

South Africa and Preference.—The Federation of British Industries states that there is a feeling of general uneasiness as to the attitude which the South African Government intends to take up on the subject of the Union preference on British manufactured goods; indeed, from one reliable source it is learnt that there is a distinct possibility that the preference may be withdrawn or very considerably modified. Several correspondents point out that representatives of German trade are extremely busy just now endeavouring to secure special facilities for the opening up of South African trade with Germany. The tariff policy of South Africa is a matter for the decision of the South African Government, but at the same time the Federation feels that there are many strong arguments in favour of the maintenance and indeed increase of the present preference enjoyed by British goods, if mutual trade between this country and the Union is to increase in volume with corresponding benefits to both sides. Although the present preference enjoyed by Great Britain is of advantage, the general opinion is that in many lines it is insufficient and represents a very small concession, compared with the benefits which South Africa has derived in the past from the large purchases by Great Britain of her products, and from the financial assistance accorded by means of British loans, and compared with these and other advantages which she may expect to receive in future.

Unemployment.—The Employment Exchange returns for the week ended December 22nd recorded a total of 1,169,109 wholly unemployed persons—an increase of 10,625.

The Demand for Factory Accommodation.—MESSRS. LEOPOLD FARMER & SONS inform us that the demand for factories, wharves, warehouses, land, &c., in 1924, far exceeded that of 1923. Prices have been maintained and the sales effected by Messrs. Farmer have embraced all classes of industry. The outlook for the current year is said to be better than ever. The firm reminds us that the re-valuation for assessment purposes of all property in the London area takes place this year, and says that ratepayers should appeal against any assessments which seem unjustifiable, in view of the need for keeping down overhead charges at the present time.

The European Glow Lamp Industry.—Supplementing the reports already published concerning the proposed development of the arrangements existing between various makers of glow lamps on the Continent, it is now announced that at the instance of the four principal producers in Germany, a conference has just been held in Paris with other Continental makers, including the Dutch works, and this is said to have led to a provisional agreement. The original agreements, which were entered into between the German producers and an American company, provided for a mutual interchange of patents and experience, and they were recently extended so as to include makers in Austria and Czecho-Slovakia. The headquarters of this international syndicate are expected to be at Geneva.

New Italian Companies.—Among the companies recently formed in Italy are the following:—Unione Radiofonica Italiana (Rome), capital 1,400,000 lire, for the working of radio-telephonic and radio-telegraphic services in Italy and abroad; Soc. An. Fabbrica Italiana Apparecchi Radiotelefonici (Turin), 60,000 lire, manufacture and trade in telephonic apparatus; Soc. An. Radio (Rome), 100,000 lire, construction of and trade in radio transmission apparatus; Società Ancnima Fabbricazione Apparecchi Telefonica (Milan), 50,000 lire; Società Italiana Radiofoni (Milan), radiotelephonic apparatus; Società Telefonica Tirrena (Leghorn), 100,000 lire, to be raised to 10,000,000 lire in 1925, to carry on the telephonic, telegraphic, and radio industry; Società Ligure Piemontese di Elettricità (Turin), 1,000,000 lire, for the construction and working of hydro-electric plants; Soc. An. A. L. E. (Castrogiovanni), 540,000 lire, water supply and lighting of Castrogiovanni; Società Elettrica Lomellina (Novara), 650,000 lire; Società Idroelettrica Valcuviana (Cittiglio), 500,000 lire; and Società Polesanor Impianti Macchinari Elettrici (Rovigne), 20,000 lire, rising to 1,000,000 lire.

Wireless Retailers' Association.—The following resolution was passed at a recent meeting of the committee of the Association:—"The Wireless Retailers' Association views with grave concern the practice of supplying goods at retailers' discounts to persons who are not *bona-fide* retailers, or who are 'private constructors.'" Copies of the resolution have been forwarded to the National Association of Radio Manufacturers and Traders, and to the Valve Manufacturers' Association.

The Dunedin Exhibition. — The magnitude of the New Zealand and South Seas Exhibition, which is to be opened at Dunedin in November, may be gauged from the fact that two of the buildings which will house the British exhibits will each have a floor area of 60,000 sq. ft. *British Industries*, the official journal of the F.B.I., states that it is uncertain as yet whether it will be possible to arrange an F.B.I. section. A number of firms have already expressed a desire to participate in such a section if it is organised, but obviously this must depend upon the total demand from firms who are unable for various reasons to arrange separate exhibits. Interested members of the Federation are asked to communicate with the Exhibition Section at the Federation's headquarters as soon as possible.

British Trade Mark Applications. — The following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from December 24th, 1924. In the case of foreign applications, the name and address of the British representatives are also given:—

Unidyne. No. 448,333. Class 8. Apparatus for radio telegraphy and telephony.—Bower Electric, Ltd., 15, Grape Street, W.C.2.

W. J. Shaw (lettering and design). No. 450,302. Class 8. Detector crystals for use in radio telephony.—William James Shaw, trading as Russell & Shaw, Willesden Green, N.W.2.

Arcolophone. No. 451,530. Class 8. Instruments and apparatus for use in radio telegraphy and telephony.—S.D.H. Manufacturing Co., 24, Stoke Newington Road, N.16.

Weco. No. 452,159. Class 8. Instruments and apparatus for use in telephony and telegraphy and radio telephony and telegraphy, including electric cables and flexibles, but not including storage batteries. No. 452,415. Class 18. Engineering, architectural and building contrivances.—Western Electric Company, Ltd.

Ravald. No. 452,422. Class 8. Instruments and apparatus for use in wireless telephony and telegraphy.—J. Moores and Co., Blackfriars Road, Salford.

Amplywhisk. No. 453,525. Class 8. Apparatus for use in radio telegraphy and telephony.—Mark Masel, Romford, Essex.

Inventum. No. 453,236. Class 18. Engineering, architectural and building contrivances.—Naamloose Vennootschap Fabriek van Instrumenten en Electrische Apparaten Inventum, 21, Leyensche-weg Bilthoven, Holland. (Phillips's, 70, Chancery Lane, W.C.2.)

Glazite. No. 132,568. Class 25. Wire covered with cotton.—The London Electric Wire Co. and Smiths, Ltd.

Cenite. No. 452,402. Class 50. Compressed fibre in sheets.—Croxsonia Co., 10, South Street, Finsbury, E.C.2.

Turrett Wireless Masts (lettering and design). No. 451,090. Class 50. Wooden masts used for radio aerials.—L. F. Gems, 171, Pitshanger Lane, Ealing, W.5.

Yavan. No. 451,577. Insulating compositions of formaldehyde sold in slabs, sheets, &c.—R. Arnot, Aldenham Road, Bushey Grove, Watford.

The date for the following is December 31st, 1924:—

Melway. No. 451,042. Class 8. Apparatus for use in radio telephony and telegraphy.—M.E.L., Ltd., Camden Town, N.W.1.

Radiolux. No. 451,705. Class 8. Radio receiving sets, cabinet loud speakers and the like. Dragon. No. 453,6[illegible] Class 8. Loud speakers.—E. A. Graham, trading as Alfred Graham & Co.

It Crowns—The "Coronet" Crystal with Gold and Silver Catswhisker (lettering and design). No. 453,599. Class 8. Crystal detectors.—Fraser & Glass, Middle Lane, Hornsey, N.8.

Autelco. No. 453,834. Class 8. Telegraphic, telephonic signalling, and radio instruments and apparatus and parts thereof.—Automatic Telephone Manufacturing Co., Ltd.

Sphinx (lettering and design). No. 430,538. Class 13. Incandescent electric automobile lamps. No. 436,656. Class 13. Incandescent electric lamps, but not including automobile lamps.—Auto-Bulbs, Ltd.

Lead.—Messrs. James Forster & Co., reporting on January 3rd, state:—"There has been an advance in the price of lead of 25s. a ton for prompt and 30s. for forward, in the past fortnight. Arrivals during December were about 20,000 tons, fully up to the previous months' average, and in consequence, no doubt due to the intervention of the Christmas holidays, the position with regard to prompt supplies is much easier. Whereas a fortnight ago it was almost impossible to obtain prompt lead, there is certainly no shortage now. The high price of lead is at last having its effect on consumption, but sentiment is still 'bullish' and will probably carry the price up higher."

Dutch East Indies Fair. — This year's trade fair at Bandoeng (Java), which is being held from June 20th to July 5th, will include an exhibition of electrical apparatus, &c. It may be mentioned that goods which are intended for exhibition are admitted free of duty, but there are certain reservations as to their disposal after the exhibition.

The East African Electrical Market.—In the course of his recent report to the Department of Overseas Trade upon the trade and commerce of East Africa (Stationery Office, 1s. 6d. net), Col. W. H. Franklin, C.B.E., D.S.O., Trade Commissioner in East Africa, says:—"The United Kingdom still dominates the market for electrical goods and apparatus, though German manufactures are beginning to make their re-appearance on the coast. The fact that certain capital undertakings are being carried out at the present time which will be spread over some few years, seems to point to the probability that the United Kingdom will retain its share of this market." Appendixes to the report give the following values of electrical goods and apparatus imported during 1923:—Kenya and Uganda, £78,267 (United Kingdom, 97 per cent.); Tanganyika, £8,572 (42 per cent.); and Zanzibar, £6,738 (66 per cent.). These figures show that trade in this branch was practically double that of 1922 in the case of Kenya and Uganda, and Tanganyika, but, in the case of Zanzibar it fell to about a quarter of the preceding year's figure.

New Australian Company.—The Metropolitan Switchgear Pty., Ltd., was recently registered in Melbourne, to acquire the manufacturing business of Tombs & Howcroft Pty., Ltd. The company's capital is £7,800, and its offices are at 371, Post Office Place, Melbourne.

Effective Film Propaganda.—The Melbourne *Age* reports that an effective electrical engineering film was recently exhibited in that city. The film was one showing the manufacture of all kinds of electrical machinery, from transformers to electric trains, at the works of the Swedish General Electric Co., of Vasteras, Sweden, and London. This film was shown to members of the New Zealand Government recently, which resulted in the company's getting a £500,000 contract for the Arapuni hydro-electric power scheme. There was a large attendance of engineers and mechanics, representatives from the Commonwealth and Victorian railways, Electricity Commission, Public Works Department, Melbourne City Council, and industrial and electrical firms of Melbourne being present. The picture, which was explained by Mr. H. S. Busch, managing director of the Swedish firm, gave a complete view of every process of manufacture of electrical machinery in the Swedish works, from the felling of trees for charcoal, the digging of iron in the mines, the forging of the steel, beating, cutting, winding, assembling and painting, until the particular machine under observation was complete and working. A fitting conclusion to this informative picture was a delightful joy ride through the snow-covered fir forests of Sweden in one of the electric trains which the audience had watched being built.

Prices Advance.—Owing to the increase in the cost of lead, Messrs. Fuller's United Electric Works, Ltd., of Chadwell Heath, announce that the prices of all accumulators and lead cables were increased as from January 1st.

Increased cost of raw materials is also responsible for an advance from the same date in all prices of portable batteries supplied by the Hart Accumulator Co., Ltd., for radio and for motor-car starter and lighting work.

B.T.H. Tramcar Equipment at Manchester. — The British Thomson-Houston Co., Ltd., has received from the Manchester Corporation a thirteenth order for tramcar equipment and the total number of equipments supplied by the company to the Corporation is now 587.

Fire at Edison Swan Co.'s Sydney Premises.—The Sydney (N.S.W.) *Sun* recently to hand reports that a serious fire occurred at the premises of the Edison Swan Electric Co., Ltd., Sydney, in November. Damage to the extent of several thousand pounds was caused to the buildings and the stock, which was not fully insured.

Municipal Showrooms.—The Electricity Committee of the Ilford Urban District Council proposes to utilise a portion of the premises, No. 57, High Road (Ilford Hill), adjacent to the Ilford Broadway, for purposes of an electricity showroom.

The Chester City Council has approved of the expenditure of £1,000 on the wiring and fitting up of the new electricity showrooms.

The Sunderland Corporation has opened a new showroom and sales department for electrical domestic appliances.

German Cable Works. — New works have lately been completed at Ketsidendorf by the Deutsche Kabelwerke Gesellschaft, of Berlin.

German Headphones in England.—The Telephone Co. (late Berliner) of Hanover reports that over 250,000 headphones have been delivered to England since the middle of 1924.

The N.S.W. Electrical Development Association.—This Association was recently formed in Sydney with an executive consisting of representatives of the principal electricity supply authorities, manufacturers and contractors of the State. Its line of action is to be modelled on the methods of the similar British and American Associations, and the Government, as well as the principal members of the three branches of the industry, have guaranteed financial backing. The Sydney *Daily Telegraph*, in reporting the formation of the Association, said that it "has shouldered a big task, but the names on the executive are in themselves a guarantee that its efforts will have a most beneficial influence on those who, in commercial, industrial, or domestic channels, are users of electricity in any form."

Lighting and Power Notes.

Aberdeen.—NEW PLANT.—The Electricity Committee has adopted a report submitted by Mr. J. A. Bell, the Corporation electrical engineer, for additional plant at the electricity works. It is proposed to install a new 10,000-kW set and two boilers, and the Committee has recommended to the Corporation that application be made for sanction to a loan of £160,000 to carry out the scheme.

Australia.—ELECTRICITY SCHEMES.—Plans are under way in New South Wales for a very large hydro-electric scheme at Jackadgery, involving an expenditure of £1,500,000, and developing 25,000 h.p. It will be capable of supplying current in bulk to Kempsey, Glen Innes, Inverell, Murwillumbah, and intermediate towns.

A deputation recently waited on the Western Australian Premier to request the Ministry to consider a plan for the establishment of an electric power station near the pit's mouth at Collie for the supply of current to Bunbury and other towns in the South-West. It was stated that the estimated output would be 4,087,422 kWh per annum, of which the collieries would absorb 63¼ per cent., the township of Collie 12¼ per cent., Bunbury 18¼ per cent., and towns on the Collie to Bunbury line the remainder. The estimated cost was £167,000. The Premier said that something might be done next year.—*Reuter's Trade Service* (Melbourne).

Barnstaple.—LOAN.—The Town Council is applying for sanction to a loan of £3,314 for mains, services, and meters.

Billingham.—ELECTRICITY SUPPLY.—The Urban District Council has declined to consent to the use of an overhead line to supply electricity in parts of the town by the Cleveland and Durham County Electric Power Co., and the company has informed the Council that it proposes to apply to the Electricity Commissioners for consent.

Birmingham.—ELECTRICITY SUPPLY.—At a recent meeting of the City Council important recommendations were made by the Electric Supply Committee. It was stated that the continued growth of the demand for electricity had made it necessary for the Committee to give its consideration to the putting down of additional plant, having regard to the considerable time required for the manufacture and starting up of large electrical machinery. The Prince's Station, Nechells, was designed for a total capacity of 105,000 kW, made up of seven sets of 15,000 kW capacity each. Expenditure covering the provision of five of these sets has already been sanctioned by the Council, three are in commission, and a fourth will be running in a week or two. This will give the effective use of three machines, allowing for one as reserve; the fifth machine is under construction, and it is anticipated will be ready for use in four or five months' time. With the plant available at the other works this will enable the estimated demand next winter to be met. The increase in the maximum demand on the undertaking is at present at the rate of 15,000 kW to 17,000 kW per annum, and the Committee has come to the conclusion that steps must be taken forthwith for the placing of contracts for the last two 15,000-kW turbo-alternator sets with condensing plant, boilers, &c., the installation of which will complete the Prince's Station equipment. The engineer's estimate of the cost of supplying and erecting the remainder of the plant is £592,350. The growth in the demands on the undertaking also calls for the apparatus at the sub-stations being increased, many of these sub-stations being at present very heavily loaded, and the Committee is of opinion that a number of extensions, as well as the erection of new sub-stations, must be put in hand during the next few months, at an estimated capital cost of £140,100. The Committee has therefore recommended that it be authorised to proceed with the extensions of plant referred to, at a total estimated cost of £732,450, and that the Finance Committee be instructed to make application for the loan sanction, &c.

Blackpool.—LOANS SANCTIONED.—The Corporation has received sanction to loans amounting to £28,000 for mains.

Chester.—EXTENSION OF SUPPLY.—The Electricity Committee has been advised as to the supply of electricity to the parishes of Kelsall, Ashton, Morton-cum-Peel, and Mouldsworth, in the rural district of Tarvin. As these parishes are in the area of the North Wales and South Cheshire Electricity District, the Electricity Commissioners are to obtain the observations of the Joint Electricity Authority for that district upon the proposal.

Continental.—GERMANY.—Referring to the water-power resources of Germany, Herr Max Nuernberg gives the following summary of the present development:—Water power resources of Bavaria, 3,000,000 h.p., of which 800,000 h.p. is being utilised; Baden, 700,000 h.p., of which 245,000 h.p. is in use; Wurtemberg, 500,000 h.p., of which hydro-electric works utilise 120,000 h.p.; Central Germany, 800,000 h.p. and 300,000 h.p., respectively; and the remainder of Germany 1,000,000 h.p., of which 400,000 h.p. is utilised. The total resources are given as about 6,000,000 h.p., and the power used as 1,865,000 h.p., or 30 per cent.

FRANCE.—The Société des Forces Motrices Bonne et Drac has recently applied for a concession to utilise the Sautet falls on the river Drac in the Department of Isère for generating electricity. La Société des Forces Hydrauliques des Lacs du Haut Venen has also applied for a concession to establish a plant to utilise the water power of the Muzelle and Lovitel lakes in the same Department.

As a result of the increasing demand, the central station at Valenciennes of the Société d'Electricité de la Région de Valenciennes-Anzin has for some time been working at full capacity. The company is therefore building a new generating station at Lourches which will enable it to supply not only the high-pressure demand but the growing l.p. requirements resulting from the rural electrification which is taking place in the district.

As a result of long negotiations the Société Nantaise d'Eclairage et de Force par l'Electricité has secured a new 40 years' concession from the municipal authorities of Nantes to expire on August 24th, 1963. In order to meet the increasing demand for electricity a new 10,000-kW turbo-generator set has recently been installed.

BELGIUM.—During the past year, two obsolete 3,200 kW generators at the central station at Jeumont, which supplies electricity to that town, have been replaced by two new sets, each of 6,000 kW capacity.

SWITZERLAND.—The Bundner Kraftwerke Gesellschaft has decided to proceed with the construction of a new hydro-electric power station at Davos-Klosters. It is to be designed to accommodate two sets of 5,000-kW turbo-generators, of which only one will be at first installed.

Finchley.—NEW PLANT.—The Urban District Council proposes to install a 3,000-kW turbo-alternator and an additional boiler at an estimated cost of £33,000, and application is to be made for sanction to a loan to carry out the scheme.

Guildford.—NEW POWER STATION.—At a recent meeting of the Town Council a scheme which will cost £140,000, and includes the erection of a new power station, was approved. It was stated that the original scheme had been enlarged to meet the views of the Electricity Commissioners.

Ilford.—MAINS EXTENSIONS.—The Electricity Committee has approved a scheme for extension of mains in the Barkingside and Hainault portions of the district, amounting approximately to £6,600.

London.—BATTERSEA.—The Electricity Committee has recommended to the Borough Council that the following expenditure be met out of the surplus of £15,547 on the electricity undertaking for the year ended March 31st last:—(1) £3,374 for meters; (2) £6,180 for plant, machinery, &c.; (3) £2,000 for purchasing property adjoining the power station, Lombard Road, being the difference between the loan sanctioned and the purchase price of the land.

Maesteg.—INAUGURATION OF SUPPLY.—The electricity supply for the town was formally inaugurated on December 27th. Electricity is purchased in bulk from Messrs. North's Navigation Collieries. Sub-stations have been erected at Caerau and Maesteg.

Maidenhead.—ELECTRICITY IN BULK.—The Town Council has decided to open formal negotiations with the Metropolitan Electric Supply Co., Ltd., for a bulk supply of electricity. When the last oil engine was installed the Electricity Commissioners intimated that with regard to future supplies it was desirable that the Council should obtain electricity in bulk from the company named instead of further extending the plant.

Melton Mowbray.—ELECTRICITY SUPPLY.—After prolonged discussion the Urban District Council has decided to defer the proposal to purchase the Melton Mowbray Electric Light Co.'s undertaking. According to a statement on the subject made by one of the members of the Council it appears that the Electricity Commissioners suggested that it might be more advantageous to the Council to secure a revision of the company's charges; and there was the further consideration that the whole subject of the country's electricity supply was going to be reviewed shortly by the Government. In consequence the time was not considered opportune for the venture. If the Council could not secure reductions of the charges imposed by the company it would appeal to the Commissioners.

Paisley.—BREAKDOWN.—A failure in the electricity supply was caused recently by the wires conveying the new bulk supply from Greenock to Paisley being blown down by the gale.

Plymouth.—LOAN.—The Town Council is applying for sanction to a loan of £3,900 for mains in connection with the supply of electricity to Crownhill Barracks.

Richmond (Yorks.).—SPECIAL ORDER.—The Town Council is applying for a Special Order authorising it to supply electricity within the borough, and also to the parish of Hipswell.

United States.—COMMENCEMENT OF LARGE STATION.—The Texas Public Utilities Co., Dallas, is shortly to commence the construction of a new power station designed for an ultimate capacity of 150,000 kW. The station is to be built in the vicinity of extensive lignite beds which are said to be sufficient to keep the station running for 20 years. The initial installation will comprise two 20,000-kW sets with the necessary high-pressure steam plant. The boilers will be designed for the burning of lignite, but arrangements will be made to facilitate a change-over to oil or gas if this is considered more suitable at a future date.

ELECTRICITY SCHEMES.—The third and last 30,000-kW turbo-generator to be installed at the Colfax plant of the Duquesne Light Co. at Pittsburgh has been put into commission. According to the *Electrical World* the total rating of the plant at this station is now 150,000 kW. The company is shortly to commence work on the erection of a power station at Shippingport, in Beaver Co., on the Ohio river, which will have an ultimate capacity of 375,000 kW. The estimated cost of the scheme is $30,000,000.

Walthamstow.—LOAN SANCTIONED.—The Urban District Council has received sanction to a loan of £55,000, for plant extensions at the electricity works. The total sum applied for was £66,444, and in respect of the balance the Electricity Commissioners have asked for further details in connection with the extension of the buildings.

Whitchurch (Hants.).—INQUIRY.—An inquiry was held on December 18th, by Col. Ekin, into the applications of the Whitchurch & District Gas Co. and A. Stevens & Sons, for Special Orders to supply electricity to part of the rural district. It was stated that the Rural District Council objected to the application of the Gas Co., on the ground that it was not in the interest of the parishes in the proposed area that the supply of electricity should be in the hands of the Gas Co. if there were others to supply electricity. There was also objection to the use of a proposed site for the erection of a generating station. On behalf of Stevens & Son it was stated that in February last the firm approached the Rural District Council with a view to an agreement for an unauthorised undertaking. The Council approved of the form of agreement, but before it was completed the Gas Co. applied for an Order.

Tramway and Railway Notes.

Continental.—SPAIN.—The new underground railway in Barcelona linking the centre of the city with the north-western suburbs of San Gervasio and Gracia was opened on December 30th last.

Fleetwood.—NEW ROUTE.—The Urban District Council has approved of extensions of the tramway at Bold Street, the Esplanade, and Pharos Street.

Halifax.—TRAMWAY EXTENSIONS.—The Tramways Committee has decided to extend the tramway from Skircoat Green terminus along Dudwell Lane to Salterhebble Lane, linking up there with the Huddersfield system.

London.—NEW ELECTRIC RAILWAY.—On January 5th the line from Baker Street to Rickmansworth, which has been electrified, was opened for traffic. The distance from Baker Street is 17 miles, and 23 miles of single track has been electrified. This section will subsequently include the new branch to Croxley Green and Watford, which is nearing completion.

Longridge-Hellifield Light Railway.—The Longridge-Hellifield light railway scheme has again been brought to public notice by a new financial arrangement between the promoters and the Ministry of Transport. The Ministry has guaranteed certain interest on the capital subscribed, and the company has obtained consent to abolish preference shares entirely, giving all an equal share in the guaranteed interest. The Ministry's grant is equivalent to 4 per cent. on the £150,000 ordinary shares for ten years. There is a prospect of the work commencing early in the New Year.

Lytham-St. Annes.—PURCHASE OF UNDERTAKING.—The newly-formed Lytham-St. Annes Borough has acquired the tramway undertaking at a cost of nearly £140,000, and at last week's meeting of the Council it was stated that additional schemes were on foot with an initial cost of £230,000 and £515,000 when completed. The Council's debt amounts to £534,000.

Manchester.—TRAMWAY EXTENSIONS.—A scheme for the extension of the Princess Road tramway at a cost of £3,366 has been approved by the Works for Unemployed Committee of the Corporation with a view to alleviating unemployment during the winter months.

South Africa.—JOHANNESBURG.—The municipal tramway department is to purchase 20 motor-omnibuses at a cost of £30,000 to supplement the existing tramway services.—*Reuter's Trade Service* (Johannesburg).

United States.—NEW YORK.—*The Times* New York correspondent reports that the New York City Board of Estimates has voted an appropriation of $19,500,000 for additional subways. One of the two underground lines covered by the appropriation will be in the Washington Heights section in the north of the city, and the other will continue through to Brooklyn the existing cross-town subway in Fourteenth Street. This appropriation represents only a small portion of the total outlay for new subways planned by the city. Other work, however, is being delayed by the attempts to bring all of the city's elevated and subway lines under municipal ownership.

West Yorkshire.—MOTOR-'BUSES.—Halifax and Huddersfield Corporation tramway departments have reached an agreement for the running of motor-'buses over each other's tramway routes between Huddersfield, Brighouse, and Bailiff Bridge, and between the centres of Halifax and Huddersfield. Halifax Corporation has also agreed to enter into negotiations with Bradford Corporation with a view to linking Halifax and Bradford by motor-'bus service.

Telegraph and Telephone Notes.

China.—NEW RADIO STATIONS.—The Woosung Hydrographic Bureau is, according to *Indian Engineering*, establishing a number of radio stations along the sea coast. A station at Tungshan (Kwangtung province) is being built and another at Shenkiamen (Chekiang province), a fishery centre in Tinghai.

Czecho-Slovakia.—NEW RADIO STATIONS.—There has just been completed at Podebrady, in the middle of Bohemia, a large radio station of a range of 3,000 km., with two secondary stations of 2,000 km. at Bratislava and Kosice respectively, the former for communication with the Balkan States and the latter with the Near East. The installation of other stations of less importance is also in contemplation. The station at the aero port of Kbely was started at the end of 1922; in the year following stations at Karlovy Vary and Ckeb were installed. The station at Bratislava was established in the interest of the navigation of the Danube and of the Danube International Commission. The transmitting station at Podebrady corresponds with Paris, Berne, and Bucharest, while the Kbely station is destined to spread market and newspaper reports from France, Germany, Switzerland, and England, and to serve the aerial lines which meet at Prague. Government and legal regulations have been modified in a liberal and modern spirit.

Gibraltar.—TELEPHONE DISPUTE.—In consequence of the dispute which arose some months ago over the price to be paid to the concessionaire as compensation for the existing telephone service, which it is proposed to replace by one managed by the municipality, the concessionaire announced the discontinuance of the service from midnight on December 31st. As a result the Government published in the *Official Gazette* an ordinance empowering the Governor to appoint a controller to seize and operate the telegraph, telephone, water, gas, and electricity services in the event of an unreasonable stoppage being threatened, but the concessionaire withdrew his notice on the following day.—*Reuter.*

(*Continued on page 63.*)

The Honours List.

Science and Engineering Recognised.

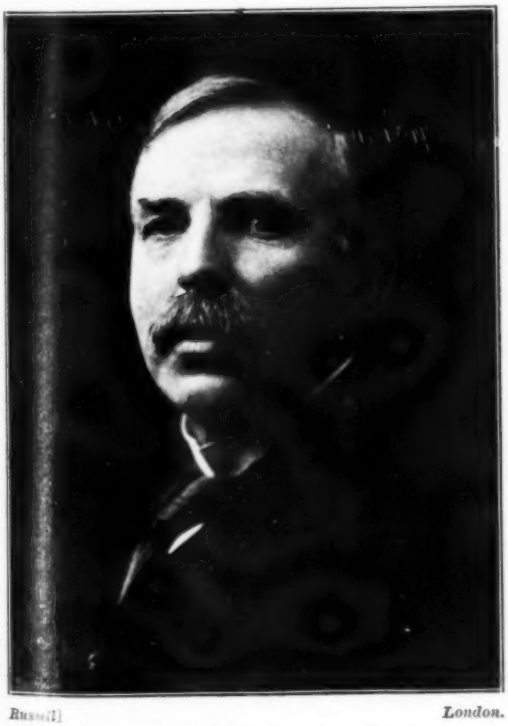
THOUGH the New Year Honours that have fallen to Electrical Science and Industry are not numerous, they are representative, well-merited, and, we believe, will be cordially approved.

In bestowing upon Sir Ernest Rutherford, F.R.S., the very high distinction of the Order of Merit—an honour which marks only the truly great (Lord Kelvin was amongst the first to hold it) and is therefore most coveted—His Majesty has recognised the exceptionally valuable services which Sir Ernest has rendered to science by his investigations of the structure of the atom. An account of his career was given in our issue of May 26th, 1922. To him was due the identification of the particles shot off by radioactive substances, and the epoch-making conclusion that the atom consisted of a minute nucleus surrounded by planetary electrons — an hypothesis which has revolutionised atomic physics and has become the foundation of a vast structure of physical science. His achievements are due to unique experimental skill combined with a mental insight into the meaning of his observations which almost transcends genius. Being only 52 years old, he will probably accomplish still greater things in the future; and doubtless further honours are in store for him.

Lafayette *[Manchester.*

Sir Benjamin Longbottom, M.I.E.E.,
Chairman of the B.E.A.M.A.

Royal recognition of the place that is filled by Electrical and Allied Engineering Industry in modern life is found in the honour of knighthood that has been conferred upon Mr. Benjamin Longbottom, M.I.E.E., Chairman of the British Electrical and Allied Manufacturers' Association. This distinction may be borne with feelings of justifiable pride by Mr. Longbottom, for it comes to him at the end of a very strenuous period of valuable service rendered to the electrical and allied industries at Wembley in connection with the Exhibition and with the World Power Conference, and after many years of self-sacrificing and efficient hard work in the affairs of the electrical manufacturers' organisation and latterly as the chairman of its Executive. The efforts of "Sir Benjamin," as he will henceforth be described, are highly appreciated by those who are familiar with them. His interest lies right at the heart of electrical industrial affairs, and the story of his manifold activities and connections was set forth in the Jubilee Issue of the ELECTRICAL REVIEW (November 17th, 1922, page 695). Sir Benjamin Longbottom, M.I.E.E., M.I.Mech.E., is managing director of Electromotors, Ltd., of Openshaw, Manchester, over whose operations he has presided for a quarter of a century—



Russell *London.*

Sir Ernest Rutherford, O.M., F.R.S.,
Cavendish Professor of Experimental Physics.

Sir E. W. Petter,
President of the British Engineers' Association.

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just one half of his lifetime. He is also a director of Lo-Thermo Motors, Ltd., and vice-chairman of Richard Johnson, Clapham & Morris.

Mr. E. W. Petter, whose knighthood also follows upon an exceptionally busy period of service for the engineering industry, he being the president of the British Engineers' Association, which it will be recalled was responsible for a very large part of the exhibits in the Palace of Engineering at Wembley last year, is a man of many public interests. Chief amongst these, however, is the well-being of the engineering industry, the difficult problems of which he has made the subject of expert study and of sympathetic counsel. Reference to leading points in his career will be found in our issue of July 20th, 1923. Sir E. W. Petter is managing director of Vickers-Petters, Ltd., of Ipswich, and chairman of Petters, Ltd., of Yeovil. Thirty years ago he and his brother were working experimentally on engines for motor-cars, and he is to-day a recognised authority on the internal-combustion engine.

Water-Power in Nova Scotia.

SINCE August, 1919, Nova Scotia has had a body, appointed by the Provincial Government, known as the Nova Scotia Power Commission, which functions in a manner similar to the Hydro-Electric Power Commission of Ontario, though on a very much smaller scale.

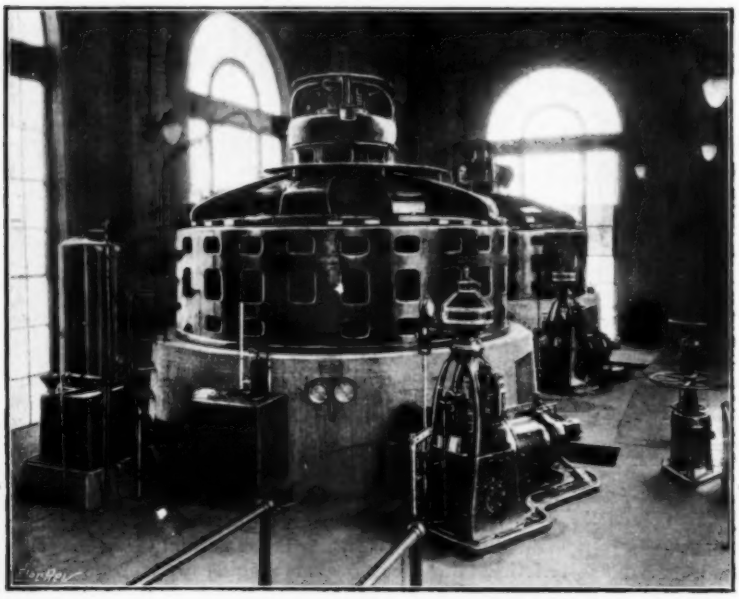

Fig. 1.—Interior of the Tidewater Station.

The Nova Scotia Power Commission is at present operating five hydro-electric developments, ranging in capacity from 5,800 kVA to about 700 kVA.

The largest plant is in the St. Margaret's system at Tidewater, about 19 miles from Halifax, operating under a head of 90 ft.

Fig. 2.—A 38-ft. diameter Surge Tank.

There are two turbines of 3,450 h.p. each, running at 300 r.p.m., and the generators are 3-phase, 60-cycle, 13,200-V machines, rated at 2,900 kVA each (fig. 1). Water is conveyed to the plant from an intake dam by a wood-stave pipe line 10 ft. in diameter, and 3,400 ft. long (fig. 4). Surges are taken care of by a differential surge tank, 38 ft. in diameter, connected to the pipe line (fig. 2). Power is transmitted to Halifax. Fig. 3 illustrates a part of the transmission line.

The latest plant is one now under construction at the mouth of East River. This involves the construction of a canal 6,100 ft. long, and a tunnel 300 ft. in length and 12 ft. in diameter. Two generating sets are being installed, and provision is being made for a third. The generators will be 3-phase, 60-cycle, 6,000-V machines, rated at 2,500 kVA each. This station will supply a pulp and paper industry about three miles away.

The Commission has several other developments in view for the future. Compared with the huge water powers available in Ontario and Quebec, those of Nova Scotia seem unimportant; nevertheless, the Nova Scotia Power Commission's activities are evidence of the fact that the people of that province wish to take full advantage of the fact that they possess water power which will prove highly advantageous when properly

Fig. 3.—Part of Transmission Line to Halifax.

developed. The most recent statistics show that the water power available in Nova Scotia is approximately 21,000 h.p. at ordinary minimum flow, or 128,000 h.p. for six months of the year. The total capacity of plant installed is put at 55,000 h.p.

Nova Scotia, it must be remembered, has plenty of coal within her own borders, and hydro-electric development is, therefore, not so vital a matter as it is in Ontario and Quebec; no doubt this fact will tend to retard the rate at which water power will be made use of.

Fig. 4.—Mill Bay Dam and Wood-Stave Pipe Line.

A West of Scotland Interconnection Scheme.

The Inauguration of the Greenock-Paisley Section.

A SUCCESSFUL attempt at co-ordination of the electricity supplies in the West of Scotland has been made in the scheme for linking up the electricity undertakings of Greenock, Paisley, and Kilmarnock (the last-named being now incorporated in the Ayrshire Electricity Board). The scheme is the outcome of the Electricity Commissioners' refusal, under the provisions of the Electricity (Supply) Act of 1919, to allow Paisley to extend its existing generating plant and, incidentally, it also marks the first step in Scotland giving effect to the Commissioners' recommendations for co-ordinating and centralising electricity supplies generally.

However, Mr. E. T. Goslin, general manager of the Clyde Valley Electrical Power Co., informs us that the company has entered into an agreement whereby it receives a bulk supply from the generating stations of the Corporation of Greenock and the Ayrshire Electricity Joint Board for distribution in a portion of the company's area, including a bulk supply to the burgh of Paisley.

The Greenock-Paisley part of the project has been completed, and on December 4th, 1924, the electricity was accepted, thus providing for the interconnection of the 50-cycle power stations of these three undertakings.

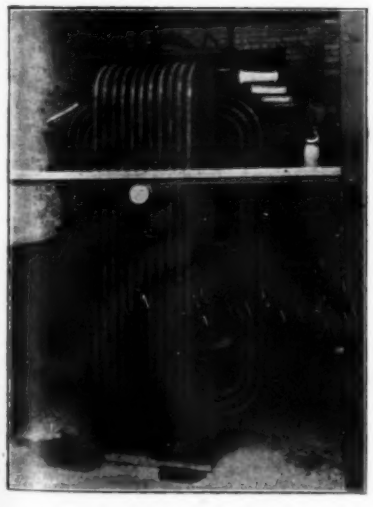

Fig. 1.—One of the 3,000-kVA Hackbridge Transformers at Greenock, 22,000-V Side.

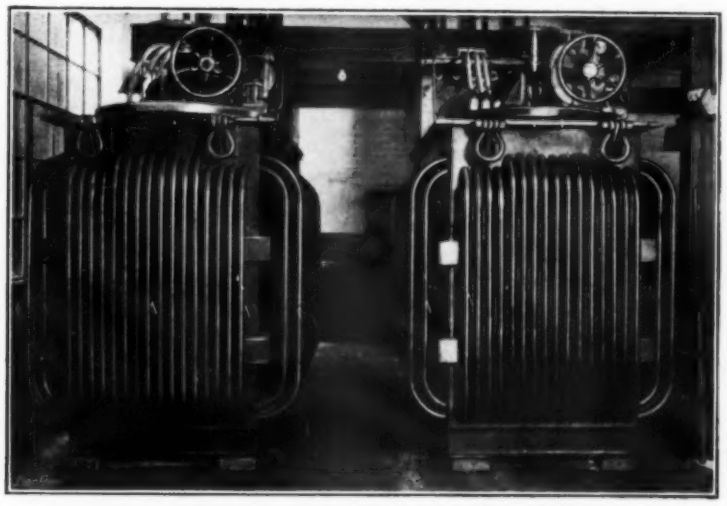

Fig. 2.—Two Metropolitan-Vickers Induction Voltage Regulators at Greenock.

Last year the load conditions at Paisley, together with the anticipated future requirements of the community, made it clear that some measure of relief to the existing generating plant would be necessary, and invitations were extended to the large neighbouring undertakings of Glasgow, Greenock, and Kilmarnock Corporations and the Clyde Valley Electrical Power Co. to quote for a bulk supply. The Clyde Valley Electrical Power Co. and Glasgow Corporation were at a disadvantage in so far that their frequency of supply, 25 cycles per second, differed from that of Paisley, which is 50 cycles, although their mains were near to Paisley's boundaries. The ultimate result, however, was that a joint scheme put forward by the Corporations of Greenock and Kilmarnock for a bulk supply to Paisley

supply from Greenock to Paisley was switched on for the first time, as was briefly recorded at the time. The scheme, for the following details and illustrations of which we are indebted to Mr. F. H. Whysall, M.I.E.E., chief engineer and manager of the Greenock undertaking, involved the construction of a 22,000-volt overhead transmission line from Greenock to Paisley, together with the necessary transformers, induction regulators, switchgear, &c. As the Kilmarnock Corporation already had an overhead line operating at that voltage within measurable reach of Paisley, the capital expenditure involved in its part of the scheme has not been so great as in the case of Greenock.

The key diagram (fig. 3) shows fairly well the nature of the scheme at Paisley, as provided for by both under-

takings, while the second diagram (fig. 4) shows the disposition of the apparatus at Greenock. The transforming plant installed at the Dellingburn power station of the Greenock Corporation in connection with the scheme consists of two Hackbridge 3,000-kVA, oil-immersed, delta-star connected transformers, fitted with oil expansion chambers (fig. 1). The ratio of the transformers is 3,300/22,000 volts, with six tappings on the 22,000-volt side arranged to give adequate flexibility of control during all conditions of load that may arise in

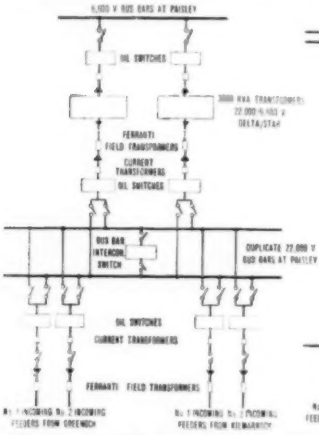

Fig. 3.—Key Diagram; Paisley.

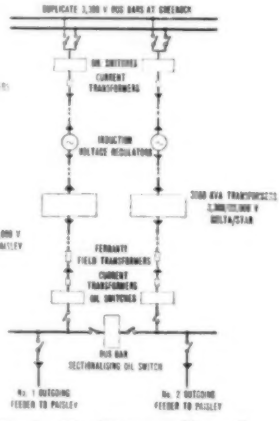

Fig. 4.—Key Diagram; Greenock.

the interchange of power between Paisley and Kilmarnock.

The transformers at the Paisley end of the Greenock and Kilmarnock transmission lines are of similar size and construction to the above two, although in this case the transformation ratio is 22,000/6,600 volts.

Two 3-phase, oil-immersed, self-cooled, induction voltage regulators (fig. 2), made by the Metropolitan-Vickers Electrical Co., Ltd., are provided at the Greenock station. They are double-wound and capable of exercising a "buck" or boost of 7½ per cent. at full load on the primary side of the Greenock transformers previously referred to. A ¾-h.p., 250-volt, d.c. motor, operated from the transformer-control panel in the engine room, is mounted on top of each regulator and by means of worm-reduction gearing enables the rotor to be moved to the required position at varying conditions of load. Limit switches prevent the rotor moving beyond the maximum positions, while a magnetic brake on the motor prevents the regulator overshooting. The regulators are also arranged for hand operation in cases of emergency.

The 22,000-volt switchgear at Greenock (fig. 5) was supplied and installed by the Metropolitan-Vickers Electrical Co., Ltd., and consists of five moulded stone and brickwork cubicles—two for the control of the transformers, two for the feeders, and one bus-bar sectionalising cubicle. They are equipped with 200-ampere isolating links and 300-ampere, type H oil switches. In each of the transformer cubicles there are also three oil-immersed current transformers, Z connected, ratio 100/5 amperes, and one single-phase, oil-immersed potential transformer, ratio 22,000/110 volts. The oil switches are designed for a maximum rupturing capacity of 300,000 kVA, while those controlling the transformers are fitted with buffer resistances for limiting the charging currents when switching in. The switchgear is arranged for remote electrical operation, and the control panels conform with the existing board in the engine room, the arrangement being the well-known desk-type black enamelled slate panels. For the transformer cubicles, the control panels are each fitted with two Ferranti-Field fault protection relays and one polyphase overload time-limit relay, together with the induction regulator controller and the usual indicating meters, oil switch controller, pilot lamps, fuses, &c. The bus-bar interconnector panel has no special devices fitted.

A year or two ago the Greenock undertaking carried out an extension to the switchgear equipment at the generating station in the form of a new switch annexe, and as opportunity was then taken to build and equip a few spare cubicles, it has not been necessary to erect new switchgear for controlling the 3,300-volt side of the Greenock-Paisley transformers. Certain alterations and additions have, however, been made to the cubicles and control panels which have been utilised. The oil switches were rated at 600 amperes, and with the addition of buffer resistances, were considered quite satisfactory. Larger current transformers having a ratio of 600/5 amperes, the provision of three single-phase, air-cooled potential transformers, and heavier cabling connections were the other main alterations made. On each of the control panels there have been mounted, in addition to the leakage and overload time-limit relays, two integrating watt-hour meters both fitted with non-return gear, one to register the outgoing energy and the other the incoming energy. A further addition has been the synchronising arrangement for the occasions when a supply may be received from Kilmarnock.

For the 22,000-volt supply at Paisley, Messrs. A. Reyrolle & Co.'s type "A" ironclad truck-type switchgear has been employed. As in the case of the 22,000-volt switchgear at Greenock, 300-ampere oil switches and Ferranti-Field leakage transformers are provided, although in this case the oil switches have a rupturing capacity of 250,000 kVA. The 6,600-volt

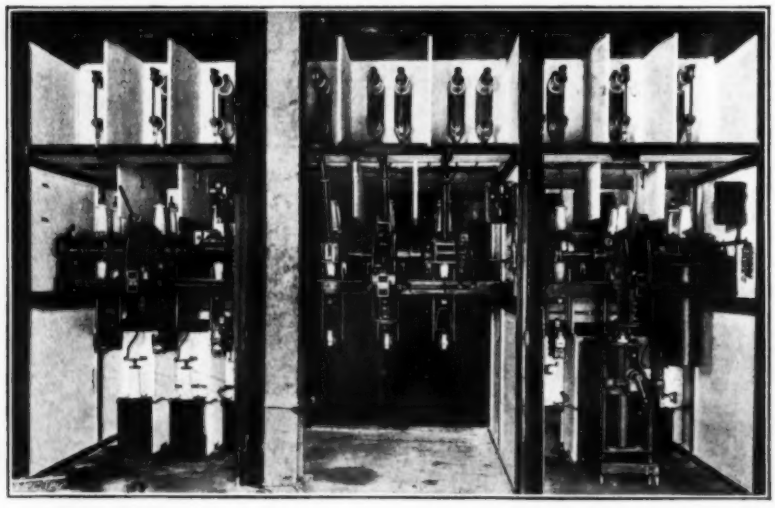

Fig. 5.—Part of the 22,000-V Metropolitan-Vickers Switchgear at Greenock; Interior of Cubicles, Oil-Switch Buckets Removed.

Fig. 6.—Callender-Kay Terminal Poles at the Greenock end of the 22,000-V Overhead Transmission Line.

switchgear at Paisley is of Messrs. Reyrolle's type "B," and has been arranged to line up with existing ironclad gear of similar make. The oil switches are rated at 800 amperes, the maximum rupturing capacity being 250,000 kVA. Synchronising gear is fitted on both sets of switchgear.

The official metering of the supplies between all the stations is carried out at Paisley. On each of the four feeders from Greenock and Kilmarnock there are connected four watt-hour meters—two "in" and two "out"—to register the energy flowing between Greenock and Kilmarnock. On the 6,600-volt side of each transformer at Paisley there are also four watt-hour meters—two "in" and two "out"—for registering the bulk supplies to Paisley from Greenock and Kilmarnock. All the meters have been duplicated for checking purposes and, in addition, two sine meters have been provided on the 6,600-volt side of the Paisley transformers to measure the average power factor.

The 22,000-volt transmission line between Greenock and Paisley has been supplied and erected by Messrs. Callender's Cable & Construction Co. The total length of the line is 16½ miles, 13½ miles of which is overhead and three miles underground.

From the Dellingburn power station at Greenock two 3-core, 22,000-volt, 0.10 sq. in. paper-insulated, lead-sheathed, and steel-tape armoured cables proceed underground for a distance of half a mile southwards through the town to the beginning of the overhead line at a point near the Cartsburn. From there the line is overhead to Paisley, with the exception of a short part on a private estate and at one of the road crossings; from the outskirts of Paisley the line goes again underground through the town to the power station. These 3-core, 22,000-volt cables are laid direct in the ground side by side, with a clearance between cables of one foot, and covered on top with 6 in. by 1 in. impregnated wood boards. For the small lengths of underground work at the road crossing it was decided to adopt three single-phase cables, as it was thought that by dispensing with the large dividing boxes on the poles on either side of the road fault troubles would be minimised; also, in the event of a fault occurring, it would be more quickly located and repaired.

The well-known Callender-Kay pole has been used in the construction of the overhead line (fig. 6). The pole is built up of high-tensile steel tubes and steel wire ropes, each tower consisting of five tubes and two ropes with their accessories. The five tubes, which are covered on the outside with compounded hessian to reduce maintenance costs, meet at a point about 15 ft. above the ground, the total height of the pole from the ground being 44 ft. The normal spacing between poles is 500 ft., although in some instances larger spans have been permissible owing to the favourable contour of the ground.

As a measure of precaution against breakdown, and also to obtain flexibility of operation in the interchange of supplies between the stations, the line carries six conductors—two per phase—mounted on pin-type porcelain insulators, and spaced 4 ft. 6 in. apart. Each conductor consists of 4/0's copper wire, equivalent to a cross sectional area of 0.1257 sq. in. Rock in fairly considerable quantities was encountered during the excavation work in connection with the construction of the line; where hard, the towers were bolted directly to its surface, but in many places decay had rendered the rock soft and dangerous, in which cases it was removed by blasting and a firm foundation made for the towers.

The district between Greenock and Paisley comes within the Clyde Valley Electrical Power Co.'s authorised area of supply, and as the transmission line passes through this area, an arrangement had to be made with the company. In this connection an agreement has been made with the Clyde Valley Co.—which, by the way, is the largest electrical power company operating in Scotland—to give bulk supplies to certain villages *en route*. The line passes close to the villages of Kilmacolm and Bridge of Weir, and terminal towers have been erected there to enable supplies of electricity to be tapped off. Any supplies so received will, of course, be transformed and distributed by the Clyde Valley Co.

It will be observed from fig. 3 that the lay-out of the feeders, transformers, switchgear, &c., is so arranged as to enable Greenock and Kilmarnock to supply Paisley independently or in parallel, and also to enable the supplying stations to interchange power with each other.

Telegraph and Telephone Notes.

(*Continued from page 58.*)

Dominican Republic.—AUTOMATIC TELEPHONY.—The Department of Public Works of the Dominican Government has sent out circulars to determine the number of prospective subscribers, should an up-to-date automatic telephone system be installed in the city of Santo Domingo, says *Commerce Reports*. The present system is out-of-date and has few subscribers.

Sweden.—NEW RADIO STATION.—The large new radio station at Vorberg, which recently commenced commercial operation, is intended for transatlantic communication, and uses a wavelength of 18,000 metres. It is equipped with two high-frequency generators capable of developing 200 kW, energy being derived from the hydro-electric undertakings at Yugaredsfors and Trollhättan. The antenna is 2,300 metres in length and is carried on six masts varying from 110 to 130 m. in height. The receiving station is at Kungsbacka.

Switzerland.—CALL BOXES.—The Swiss telephone authorities, after exhaustive tests of the Hall automatic system, have decided to adopt it in connection with a number of public telephone call boxes in the principal thoroughfares of the more important cities and towns.

The Telephone Service.—NEW EXCHANGES.—It is reported that an exchange is to be provided for Twickenham, Middlesex, and also that a new exchange is to be built at Bournemouth.

At Birkenhead a new exchange was put into service on January 3rd. The old exchange in Price Street, which housed 2,650 lines and 500 junctions and private wires, was transferred to Palm Grove. It is estimated that the new premises will suffice for 20 years' development up to a maximum of 6,400 lines.

STORM DAMAGE.—The rough weather has considerably disorganised the telephone services, even the underground cables suffering from flooding. Continental lines were affected, and twelve of the fourteen Paris lines were out of order. Brussels, Amsterdam, and Rotterdam had lines down, but the wires from this country were in general not affected. The faults on inland traffic circuits increased during last week-end, but the majority were minor defects, which it was hoped to repair quickly. In connection with local exchanges, many Richmond subscribers were without a service, several hundred lines being affected. Clissold had 67 lines out of order, and Hampstead 43. Many other London exchanges had some twenty lines each not working. The faults throughout the country were of a varied character. In some cases overhead lines had been blown down or branches of trees broken off by the wind had been blown across them. In the case of underground cables water getting in necessitated a more or less lengthy process of "drying out" before the circuits were again normal. The telephone maintenance staff were hard at work, but as they sometimes had to travel a considerable distance before locating a fault, repairs were necessarily proceeding slowly.

Radio Notes.

Austria.—ENTERTAINMENT TAX.—The Municipality of Vienna has asked the management of the Vienna Broadcasting Co. to show cause why it should not be subjected to the entertainment tax enforced by the city on the organisers of all entertainments and celebrations, casual and regular. The city, which itself is a large shareholder in the Broadcasting Co., is willing, says *The Times*, to compromise in the matter of the amount of the tax, which legally is one of 30 per cent. It is prepared to levy 5 per cent. only on the amount collected by the concern from its subscribers, only stipulating in return that the Broadcasting Co. shall henceforth apply the highest possible standards in the selection of its programmes. The legal right of the city to levy the entertainment tax appears indisputable, and the Broadcasting Co. will, it is expected, accept the terms offered.

According to *Commerce Reports*, a leading Vienna dealer estimates that there are already over 50,000 receiving sets

in Austria, although the broadcasting service is only a few weeks old. The interest is chiefly among the poorer classes, who are content with the cheaper apparatus.

Broadcasting at Sea.—LICENCES.—Applications for the special form of licence for broadcast reception at sea number about 50, says the *Daily Mail*. They are issued by the Post Office for people in private vessels or liners that receive broadcast for the passengers, and for operators and other members of crews who own private sets.

Czecho-Slovakia.—BROADCASTING.—The Government's decree of April, 1924, gives encouragement to the construction of amateurs' installations. The subscription to the broadcasting Radiojournal company has been lowered 60 per cent. A network of radio clubs newly formed promotes broadcasting, the public appreciating the transmission of the Radiojournal. A new industry has started to satisfy the wants of the ever-increasing number of amateurs. With a view to helping the growth of the radio industry and the extension of broadcasting, the management of the Prague Fair has decided to embody a special Fair Exhibition in the programme of the spring meeting of 1925, which will be held from March 22nd to 29th. The support of the Ministry of Posts and Telegraphs, as also that of the Checoslovak Wireless Constructors' Association, the Wireless Dealers' Association, and the Radiojournal company, has been secured. On the same occasion a congress of radio amateurs will be held at Prague. It is obvious that the growth of this branch of industry and trade must create outlets for oversea supplies, the Republic already being a considerable importer of apparatus pertaining to radio telegraphy and amateurs' material, and lends special interest to the forthcoming fair to be held at Prague in the spring.

Daventry.—NEW STATION.—The new high-power station of the British Broadcasting Co. at Daventry is in course of construction. The site stands 600 ft. above sea level, and the ground on which the buildings and aerial will be erected is 300 ft. above the surrounding land, which is all open country. Two masts, says *The Times*, 500 ft. high and 800 ft. apart, are to support a T-shaped aerial. The wave-length will remain at 1,600 metres, on which the temporary station 5XX, at Chelmsford, is now working. The power rating will be 25 kilowatts. The station will consist of a main building with two side wings, and will be 116 ft. long and 64 ft. wide. This will provide for a small studio for testing purposes, an instrument and test room, battery and amplifier rooms, and workshops and stores, as well as the main wireless room, and the machinery room attached. All the gear will be enclosed, so that it will be easy for parties of inspection to walk round without disturbing the working of the station or getting into danger themselves.

The earth system consists of a continuous metal plate, laid underground, like a flat ring, with a radius of 100 ft. The station will be in the middle of the ring, and from a circular support at the top of the station, through the centre of which the aerial enters the building, wires will run out to posts, 10 ft. high, planted all round the circle. The wires will be insulated from the posts and connected directly to the buried ring-plate below. Special accommodation must be provided on the site for the resident staff of engineers, and a special road is needed to approach the site, which is in the middle of agricultural land, so that there shall be perfect freedom from interference. An overhead telephone line will connect the station with the London studio, and an underground cable line will also be installed to link up with the existing cables as a stand-by in case of breakdown. The new station should be open in the spring, and will work in the afternoon and evening, providing programmes of its own on two days of the week, a provincial relayed programme on a third day, and relays of London programmes for the remainder of the week.

Holland.—NEW PLANT.—The station at Hilversum (HDO, wave-length 1,050 metres), which has been fitted by Messrs. Philips Glowlampworks, Ltd., with two steel 200-ft. high transmitting towers, was opened on Sunday, January 4th.

Poland.—RADIO REGULATIONS.—The Ministry of Industry and Commerce states that a new executive order pertaining to radio regulations in that country is being prepared and should be signed in the near future. This order, says *Commerce Reports*, although still maintaining strong governmental control of radio, will probably provide for a certain amount of private broadcasting and decrease existing restrictions on the use of private receiving sets.

SECRET STATIONS.—Two secret radio broadcasting stations operated by Communists have, according to Polish newspapers, been discovered at Vilna. They were used for communicating news of Communist activities in Poland to neighbouring countries. The directors have been arrested.

Stoke-on-Trent.—AMATEUR AID.—Colonel F. E. Wenter, who has a powerful transmission set, came to the rescue of the B.B.C. at Stoke-on-Trent on January 4th, for the second time within a few weeks. The Stoke relay station was unable to relay the London programme as announced owing to the fact that the land line from London had been blown down by the gale. The officials arranged with Colonel Wenter to receive the Chelmsford transmission and to relay it to the Stoke B.B.C. studio, whence it was broadcast.

Contracts Open and Closed.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared in our advertisement pages.)*

Open.

Army Contracts.—Manufacturers and firms who are not already on any War Office list of tenderers, and who wish to be invited to tender for Army requirements of electrical material, cables, &c., will be interested in a notice appearing in our advertisement pages, giving particulars as to where application for inclusion on the list may be made.

Australia.—SYDNEY.—February 18th. New South Wales Government Railways. Four 3-phase, 25-cycle, 500-kVA transformers. March 11th. One motor-driven ash exhauster.*

Municipal Council. March 2nd. 10,000-V feeder protective apparatus.*

February 4th. Public Works Department. Two motor-driven self-cleaning water screens.*

MELBOURNE.—March 23rd. Electricity Department. One 2,000-kW rotary converter, with transformer and accessories. Specifications from the City Electrical Engineer's office, Melbourne.—*Industrial Australian and Mining Standard.*

Barnes.—January 12th. Electricity Department. One 500-kW rotary or motor-converter, with transformer and switchgear. (December 19th.)

Belgium.—January 14th. The Belgian Post and Telegraph authorities at La Salle Madeleine, Brussels. Supply of telephone cables at Chimay, Couvin, Florennes, Fontaine l'Eveque, Gosselies, Thuin, and Ninove. Particulars (Cahier des Charges Special No. 3-80) for 6 fr. 20 c.

January 19th. Deputation Permanente du Limbourg, at Hasselt. Supply of electricity distribution mains between Hechtel-Peer, Ellicum-Gruitrede and between Kerckem-Goyer-Montenaeken-Velm. Particulars for 25 fr. from Service Provincial d'Electricité, 27, Avenue Bamps, Hasselt.

Dartford.—January 17th. Electricity Department. Extensions to the electricity department, including artesian well, 750-kW rotary converter, and e.h.p. and d.c. switchgear. (December 26th.)

Dublin.—January 23rd. Dublin United Tramways Co. (1896), Ltd. A.c. and d.c. switchgear. (See this issue.)

Dundee.—January 19th. Electricity Department. A.c. and d.c. house-service meters for 12 months. (January 2nd.)

Egypt.—CAIRO.—February 15th. Ministry of the Interior. Pumping plant.*

Glasgow.—January 13th. Corporation. Electric lighting, bells, telephones, and fire alarm installations in connection with the erection of the sanatorium at Mearns, Renfrewshire. Specifications from Office of Public Works, 64, Cochrane Street.

January 14th. Electric lighting installation at the child welfare clinic, Maryhill. Specifications from Office of Public Works, City Chambers.

Horwich (near Bolton).—January 15th. Installing electric lighting fittings at the premises of the Horwich Industrial Co-operative Society, Ltd., 86, Lee Lane, Horwich. Specifications from Mr. J. H. Wynn, general manager.

India.—February 3rd. India Store Department. Electric cable. (See this issue.)

Keighley.—January 20th. Electricity Committee. One 350-kW rotary converter, transformer, h.p. and l.p. switchgear. (See this issue.)

London.—LONDON COUNTY COUNCIL.—January 19th. 3,700 tons of standard steel girder tramway track rails, lipless track rails and fishplates, and, alternatively, 4,700 tons of such rails and bolts; 700 tons of conductor tee rails. Chief Engineer, Old County Hall, Spring Gardens, S.W.

H.M. OFFICE OF WORKS.—January 20th. 900 a.c. prepayment electricity meters. (January 2nd.)

BERMONDSEY.—January 22nd. Electricity Department. Stores for 12 months, including cables, jointing, &c., materials, conduits, meters, lighting and wiring accessories, &c. (January 2nd.)

METROPOLITAN ASYLUMS BOARD.—January 28th. Alterations and extensions to electric lighting installations at the Western Fever Hospital, Seagrave Road. (January 2nd.)

Manchester.—January 14th. Electricity Committee. Electric street lanterns, switches and cut-outs, and electric cooking ranges. (January 2nd.)

January 13th. Tramways Committee. Span-wire brackets, cast-iron finials, and copper bonds for tramway poles.

January 21st. 60 electric tramcar bodies, 60 pairs electric tramcar trucks, 120 electric tramcar motors, 120 electric tramcar controllers, or, alternatively, for the supply of 60 electric tramcars assembled complete. (See this issue.)

Rumania.—BUCHAREST.—February 3rd. Rumanian State Railways. Porcelain insulators, sleeves and plates.*

Uruguay.—MONTEVIDEO.—February 16th. State Electricity Works. Copper wire and cable.*
February 18th. 79,000 metres of lead-covered wires and cables.*
February 19th. 134,000 metres of v.i.r. wires and cables for indoor installations.*
February 27th. 3,000 d.c. meters and spares; 17,285 h. and l.p. a.c. meters and spares.*

Warrington.—January 19th. Electricity Department. H. and l.p. paper- and lead-covered cables. (See this issue.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Australia.—MELBOURNE.—Commonwealth P.M.G.'s Department.
Cables Sch. Vic. 325 (Contract 861), £258,334, British Insulated and Helsby Cables, Ltd.; (Contract 862), £34,430, British Insulated and Helsby Cables, Ltd.; (Contract 864), £30,746, W. T. Henley's Telegraph Works Co., Ltd.; (Contract 865), £3,346, Johnson & Phillips, Ltd.; (Contract 866), £18,061, Callender's Cable & Construction Co., Ltd.; (Contract 867), £25,385, Western Electric Co., Ltd.; (Contract 868), £16,580, Siemens Bros. & Co., Ltd.; (Contract 869), £5,606, Pirelli-General Cable Works, Ltd.; (Contract £870), £2,395, Enfield Cable Works, Ltd.

State Electricity Commission of Victoria.
22,000-V transformers and spares (£2,557).—R. C. Thomas Bros. Pty., Ltd.

SYDNEY.—P.M.G.'s Department.
Two 25-cell accumulator batteries (£5,154), Gibson, Battle & Co., Ltd.; two do. do. (£6,228), Tudor Accumulator Co., Ltd.
One counter e.m.f. 6-cell battery (£709), Gibson, Battle & Co., Ltd.; one do. do. (£1,611), Tudor Accumulator Co., Ltd.—*Tenders.*

Birkenhead.—Electricity Committee. Accepted:—
Three miles of twin service cable (£832).—Liverpool Electric Cable Co., Ltd.
6 miles .1 main cable (£1,721), 3 miles .05 main cable (£696), 800 yd. .2 4-core cable (£685), 1 mile .04 4-core cable (£526).—Macintosh Cable Co., Ltd.

Dublin.—Great Southern & Western Railway Co. of Ireland.
Six months' supplies of Osram and Robertson lamps.—General Electric Co., Ltd.

Eastbourne.—Electricity Committee. Accepted:—
Street lighting fittings (£161).—Cable Accessories Co., Ltd.

Egypt.—The lowest tender submitted recently to the Egyptian Post and Telegraph authorities in Cairo for the supply of 500 wall telephone sets was that of the Allmanna Telefon Aktiebolag L. M. Ericsson, of Stockholm.

Hastings.—Electricity Committee. Recommended:—
Extension of e.h.p. switchboard at the new generating station at Broomgrove (£1,632).—Ferguson, Pailin, Ltd.

Ilford.—Electricity Committee. Recommended:—
Cable (£532).—Enfield Cable Works, Ltd.

London. — ADMIRALTY. — Correction. The order for "Osram" gasfilled lamps received by the General Electric Co., Ltd., was for 5,800 not 51,000 as we were informed. (ELEC. REV., December 19th, 1924, p. 942.)

INDIA OFFICE.—Accepted.
Supply of Edison primary cells and renewals, track circuit relays, polarised relays, and signal lever contact makers for an Indian State railway.—General Electric Co., Ltd.

LONDON & NORTH-EASTERN RAILWAY (Southern Area) and GREAT WESTERN RAILWAY. Accepted:—
12 months' supply of track relays and track resistance units.—General Electric Co., Ltd.

LONDON, MIDLAND & SCOTTISH RAILWAY. Accepted:—
5,000 Osram train lighting lamps.—General Electric Co., Ltd.
Siemens helical traction vacuum train-lighting lamps.—Siemens and English Electric Lamp Co., Ltd.

ABERDEEN LINE (G. Thompson & Co., Ltd.). Accepted:—
Six months' supply of electric lamps.—Siemens & English Electric Lamp Co., Ltd.

Leeds.—Electricity Committee. Accepted:—
Cables.—Enfield Cable Works, Ltd. (£3,194); W. T. Henley's Telegraph Works Co., Ltd. (£2,304); Macintosh Cable Co., Ltd. (£1,028).

Maidenhead.—Town Council. Accepted:—
Replating the positive half of the battery to a capacity of 480 ampere hours and cleaning 118 cells of the negative battery (£727).—Tudor Accumulator Co., Ltd.

Salford.—Electricity Committee. Accepted:—
2,250 yd. l.p. cable; 300 yd. .04 sq. in., 3-core e.h.p. cable; 400 yd. .06 sq. in., 3-core h.p. cable (£1,117).—W. T. Glover & Co., Ltd.
Erection of static transformer sub-station, Weaste Road South, Pendleton (£665).—J. F. Moore.

South Africa.—According to *The Times*, the contract for the electrical equipment of the rolling stock for the electrification of the suburban lines of the South African railways running from Cape Town to the naval port of Simonstown and the seaside resorts of Kalk Bay and Muizenberg on False Bay and from Cape Town to Sea Point has been awarded to the English Electric Co., Ltd. The contract is between £300,000 and £400,000, and includes the electrical equipment of 83 motor coaches and 133 trailer coaches, to be operated on a 1,500-volt direct current system. The controller gear is the English Electric standard type.

Forthcoming Events.

Association of Mining Electrical Engineers (South Wales Branch).—Saturday, January 10th. At the South Wales Institute of Engineers, Cardiff. At 6 p.m. Paper on "How Power Production Costs Affect Colliery Valuations," by Mr. M. S. Stewart.

Glasgow Corporation Electricity Department Engineering Society.—Monday, January 12th. At the Welfare Hall, St. Andrew's Cross Works, Glasgow. At 7.45 p.m. Paper on "Steam Turbine Design," by Mr. R. Dowson.

Institution of Electrical Engineers.—INFORMAL MEETING.—Monday, January 12th. At the Institution, Victoria Embankment, W.C. At 7 p.m. Discussion on "Telephonic Development in Great Britain and in the United States," to be opened by Mr. W. Day.

(North-Eastern Centre).—Monday, January 12th. At Armstrong College, Newcastle-on-Tyne. Ordinary meeting.

(North-Midland Centre).—Tuesday, January 13th. At the Hotel Metropole, King Street, Leeds. At 7 p.m. Address by the President, Mr. W. B. Woodhouse.

(Scottish Centre).—Tuesday, January 13th. At the North British Station Hotel, Edinburgh. At 7 p.m. Paper on "Automatic and Semi-Automatic Rectifier Sub-stations," by Mr. G. Rogers.

(Scottish Students' Section).—Friday, January 16th. At the Royal Technical College, Glasgow. At 7.30 p.m. Paper on "The Domestic Uses of Electricity," by Dr. S. Parker Smith.

(South-Midland Centre).—Wednesday, January 14th. At the University, Birmingham. At 7 p.m. Paper on "Three-wire Direct-current Distribution Networks—Some Comparisons in Cost and Operation," by Mr. H. W. Taylor.

(Western Centre).—Monday, January 12th. At the Merchant Venturers' Technical College, Bristol. At 6 p.m. Address by the President, Mr. W. B. Woodhouse.

(North-Western Centre, Students' Section).—Tuesday, January 13th. At Milton Hall, Deansgate, Manchester. At 7.30 p.m. Paper on "Transformer Troubles," by Mr. P. Butler.

(Sheffield Students' Section).—Tuesday, January 13th. At the University, Sheffield. Smoking concert and Chairman's address.

National Association of Supervising Electricians.—Tuesday, January 13th. At. St. Bride's Institute, E.C. At 7.15 p.m. Lecture on "Modern Developments of Stage Lighting," by Mr. H. R. Leslie Groom.

Electrical Trades Commercial Travellers' Association.—Wednesday, January 14th. At E.L.M.A. Lighting Service Bureau, 15, Savoy Hill, W.C. At 7 p.m. Inaugural meeting.

Radio Society of Great Britain.—Wednesday, January 14th. At the Institution of Electrical Engineers, Savoy Place, W.C. At 6 p.m. Informal meeting. Talk on "Short Wave Reception," by Mr. S. Ward.

Association of Engineering and Shipbuilding Draughtsmen (Birmingham Area).—Thursday, January 15th. At the Chamber of Commerce, Birmingham. At 7.30 p.m. Lecture on "Private Service Motor Bodywork," by Mr. N. Rowland.

National Council of Technical Staff Associations.—Thursday, January 15th. At the Geographical Hall, Manchester. At 7.15 p.m. General meeting.

Manchester Association of Engineers.—Friday, January 16th. At the Engineers' Club, Manchester. Paper on "Pulverised Fuel," by Mr. R. Jackson.

Manchester Electro-Harmonic Society.—Friday, January 16th. At the Albert Hotel, Piccadilly, Manchester. At 7 p.m. Concert.

Royal Institution of Great Britain.—Friday, January 16th. At the Institution, 21, Albemarle Street, W. At 9 p.m. Lecture on "The Investigation of the Properties of Thin Films by Means of X-rays," by Sir Wm. Bragg, F.R.S.
Tuesday, January 13th. At 5.15 p.m. Lecture on "The Analysis of Spectra," by Mr. A. Fowler, F.R.S.

British Electrical Development Association.—Friday, January 16th. At Caxton Hall, Westminster, S.W. At 7.30 p.m. Paper on "Electrical Work in the Retail Shop and Store," by Mr. E. E. Sharp.

Junior Institution of Engineers.—Friday, January 16th. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette on "Electrical Power Transmission at 150,000 V and Upwards," by Major A. M. Taylor.

Institution of Production Engineers.—Wednesday, January 21st. At the Engineers' Club, W. At 7.30 p.m. Paper on "Instruments and Gauges," by Mr. H. A. Randall.

The "Electrical Review" Service Department.

INQUIRIES must be accompanied by a stamped addressed envelope.

We should be glad to learn the names of makers or suppliers of:—
VAC-TRIC vacuum cleaners.
HELIX bowl fires.

Notes.

Appointments Vacant.—Mains foreman for the Doncaster Electricity Supply Department. Test assistant (60s.+ bonus = 94s. 11d.) for the Royal Aircraft Establishment. (See our "Official Notices" to-day.)

Electric Cooking.—It is reported that, in order to teach pupils how to cook by means of electricity, the London County Council has installed electric cooking apparatus in two Poplar schools.

French Water Power.—According to French official statistics, the water power now being utilised amounts to 2,400,000 h.p., out of the total of 9,000,000 h.p. available for service. About 63 per cent. of the total is employed for the generation of electricity for lighting and power purposes, while the balance is used in the electrochemical and electro-metallurgical industries.

Accumulators for Motor-cars.—Impurities in the accumulators intended for use in connection with electric lighting and engine starting on motor-cars and their effect on the plates has been made the subject of a study by the U.S. Bureau of Standards. The tests have been in hand over a period of 12 months, and the results will be published in brochure form early this year. Results up to the present time show that some impurities are harmful to both plates of the battery, some to only one, while still others have no apparent effect. Preliminary investigation shows that among the impurities which affect both positive and negative plates are iron, manganese, and chlorine; bismuth, starch, and sugar affect the positive plate, but not the negative; while platinum, tin, copper, antimony, silver, nitrogen, and tungsten affect only the negative plate. Among the substances which appear to produce no harmful effect are mercury, alum, titanium, calcium, zinc, cadmium, sodium sulphate, and tannic acid. The object of the investigation is to obtain information necessary to the successful operation of motor vehicle batteries, and to serve as a guide in the preparation of specifications for sulphuric acid for the electrolyte.

Scientific Instrument Research.—The year which ended on June 30th, 1924, completed the sixth year of the British Scientific Instrument Research Association since its incorporation and was the last year of the period during which it received grants from the Department of Scientific and Industrial Research under the original conditions. The annual report of the Council shows that the hope that members would undertake to give such financial support for a further period of years as would enable the Department of Scientific and Industrial Research to continue grants to the Association for a further period has been fulfilled and the great majority of the members have increased their subscriptions. The Committee of the Privy Council for Scientific and Industrial Research, after having considered the report of the Committee of Inspection, has offered the Association an annual block grant of £10,000 for five years from July 1st, 1924, subject to the Association's raising by prescribed ways a minimum average annual sum of £1,800 for that period, and to certain other conditions, mainly administrative. The Association has now entered upon its second grant period, during which it will be brought into still closer contact with the Department of Scientific and Industrial Research and with the fighting services.

In last year's report reference was made to further work which was in progress or in contemplation on the magnetic retentivity of materials such as silk and wood. As the result of a large number of experiments to determine whether iron in these materials can be removed, or the state of chemical combination of the iron modified in directions that tend to reduce retentivity, it has been found that, without practically destroying the materials, it is not possible markedly to reduce their retentivity. Artificial silks are not as free from retentivity as well washed natural silk. Artificial silk fibres cannot be treated in so searching a manner by chemical reagents as can natural silk fibres, especially when the object is to remove any adventitious residual iron or compounds of iron after the coils have been wound. None of the materials investigated has been found as free from retentivity as specially selected wood for use as formers for coils; the nature of the substances to which silk and wood owe their magnetic properties is described in a report, which contains also the more important matters dealt with in the earlier reports on magnetic properties of materials used in galvanometer coils. With a view to obtaining a more constant rate of softening an improved X-ray tube regulator has been worked out; with this device there is a much greater reserve of gas available. Investigation of the irregular working of X-ray tubes has been commenced and a survey is being made of the whole subject. Certain alloys which might be considered as possible substitutes for platinum as relay contacts have been investigated. The conclusion is that no alloy has yet been found anything like so satisfactory as platinum; it is proposed to continue the search.

Thunderstorm Peril to Airships.—Now that airships are being re-developed, importance attaches to the possible dangers which may arise from the presence of thunderstorms along the route of a commercial airship, and some useful contributions to this problem were made in a recent discussion at the Royal Aeronautical Society by such authorities as Dr. Simpson, Director of the Meteorological Office, Major Scott, who flew the Atlantic in the R.34, and Lieut.-Colonel Richmond, who is in charge of the design and research section of the re-opened Cardington airship station. The question arose out of a paper read by Dr. Simpson at the Society's rooms upon "Thunderstorms and Aviation," in which he expressed the view that the chief dangers to airships were:—(*a*) A direct lightning stroke. (*b*) Ignition of the gas in the balloon through an internal spark. (*c*) Ignition of escaping gas through an external spark.

There was, however, no need to assume that an airship would necessarily be destroyed if struck by lightning, especially if the exterior of the hull were made as smooth as possible, so as to induce the electrical flash to strike, if it did strike, at the nose and fins, which were farthest away from the gasbags and had the weight of metal to take the heavy currents. Internal sparking was a preventible danger, and external sparking was only dangerous if it occurred near a gas vent; round such parts no ends of wires or sharp metal points should be left, though he did not consider this danger very great. Obviously, everyone agreed that the commander of an airship would avoid a storm if he could, but Major Scott indicated how precautions against the effects of running into a storm had been considered in the design of the new British airship R.101, which was to be of five million cubic feet capacity. Reference had been made to ascending air currents in thunderstorms of a velocity of 33 ft. per second (22 miles per hour), and Major Scott said that the new airship was designed to have that rate of rise and descent, so that the vessel should be able to maintain itself in such a current. He felt that the large airship of the future would be able to stand very high velocities in vertical currents, and it must not be assumed that even violent thunderstorms would be fatal. The stresses upon an airship, Major Scott pointed out, depended upon the rate of acceleration more than the velocity. Several German airships had been right through thunderstorms intact.

Lieut.-Col. Richmond dealt with the design side of airships in relation to meteorological conditions. He said that there were authentic cases of a current of electricity passing through an airship and fusing a girder, owing, of course, to a concentration of current at a part not large enough to carry the charge. The fusing occurred at the nose where the cross section of the girders was small, and the obvious protection seemed to be to provide enough metal to carry the current at the most likely points of entrance and discharge. He agreed that there should be no points to encourage lightning to enter an airship, and mentioned that in conversation with Zeppelin pilots he was given personal experiences. In these cases the airship had formed part of the path of the electrical flash, and in nearly every case the lightning struck the ship at the top forward part and left it by the control car in front or one of the wing cars.—*The Times.*

Chain Grate Stoker Performance. — By the courtesy of Messrs. W. M. Llewellyn (general manager) and D. J. Davies (agent), of the Cwmaman Coal Co., Ltd., we are able to publish the following particulars of the performance of the new type of chain grate stoker that Messrs. Ed. Bennis & Co., Ltd., have installed near Aberdare. The stoker is fitted with a new narrow type link which in practice has proved highly successful. Its advantages generally are claimed to be that owing to the larger air space area per square foot of grate, it becomes practicable to burn about 20 per cent. more fuel per square foot of grate with a corresponding increased boiler duty. The efficiency generally is also said to be increased, due to the better combustion of the fuel and to the increased cooling area of the links. Messrs. Bennis have also re-linked a large number of other grates with this special link with very satisfactory results.

The coal used at Cwmaman was the ordinary unwashed colliery rough small, being of the dry steam coal variety with a volatile of about 9 per cent. and containing from 16.5 to 22.5 per cent. of ash. During the time of testing, five other boilers of similar size were working under hand-firing conditions with forced draught and the total quantity of water evaporated was registered by means of a 4-in. Siemens water-meter; the average evaporation per boiler during the time when the official tests were being carried out is given below, together with that of the boiler under test:—

	June 18th.	June 19th.
Averages for hand-fired boilers lb. of water—actual	7,716 lb.	7,592 lb.
Ditto from and at 212 deg. F.	9,012 lb.	8,904 lb.
Average evaporation of boiler fitted with Bennis chain grate per hour actual	12,916 lb.	12,475 lb.
Ditto from and at 212 deg. F.	15,087 lb.	14,630 lb.

Thus the increased evaporation of the test boiler over the forced-draught hand-fired boilers on the two test days amounted to 67 and 62 per cent. respectively.

The duty guaranteed was exceeded by 16 and 12½ per cent. respectively, and the guaranteed thermal efficiency was exceeded by 7½ and 9¼ per cent. respectively; at the same time the results were obtained with a fuel of a lower calorific value than the one specified in the guarantee.

A Large American Sign.—The advances in the field of electrical advertising have by no means lagged behind developments in other fields. This fact has been revealed with more emphasis than ever before with the appearance within recent months of a new electric sign in New York City of enormous proportions. It is nearly a full city block in length, and is as high as a five-storey house. Over its framework 21 miles of wire distribute 267 kW of power to its 19,000 lamps. When the 29 flashers start the display beautiful colour combinations appear.

American Electric Vehicle Exports.—During October last 18 electric industrial motor vehicles, valued at $24,424, were exported from the United States, as compared with 13 ($18,712) in the corresponding month of 1923.

The Third High-pressure Conference.—The third international conference upon high-pressure networks will be held from June 24th to July 1st, when 10 questions will be submitted for special consideration.

A 110,000-V Underground Cable.—The *Electrical World* reports that the General Electric Co. (America) has under commercial test, at the North Albany switching station of the Adirondack Power & Light Corporation, a 110,000-V cable for underground transmission.

Inquest.—An inquest was held at Enfield on January 3rd into the death of Arthur Jordan, an employé of the North Metropolitan Electric Power Supply Co. It was stated in evidence that the deceased was lowering an extension ladder when it came into contact with a high-pressure conductor, causing him to receive a fatal electric shock. A verdict of "Accidental death" was returned.

Hearing by Light.—Some idea of hearing by light was given by Prof. A. O. Rankine in a lecture delivered on January 3rd, at the Imperial College of Science and Technology—one of the series arranged in aid of King Edward's Hospital Fund for London. Prof. Rankine has been devoting attention to the study of telephony through the medium of light, and he made, says the *Daily Telegraph*, interesting suggestions as to the development that is likely to take place in this process in various directions, including the dissemination of political speeches by means of talking kinema films. Hearing by light was undoubtedly possible nowadays. It was usefully and satisfactorily employed during the war without an amplifier. The lecture was dependent on the experiments with which it was illustrated.

The International Critical Tables.—At the meeting of the International Union of Pure and Applied Chemistry held in London in 1919, the American delegates submitted a proposal for the international compilation of critically prepared tables of the physical properties of chemical substances and technological materials, and the American National Research Council at Washington has undertaken the financial and editorial responsibility for the work. A Board of Trustees has undertaken to raise $200,000, and the work of critically examining the data and of compiling the various tables is being carried out by well-known chemists, physicists, engineers, &c., some 300 in number, in the various countries of the world. Each portion of the tables will be published over the name of the co-operating expert who has assumed responsibility for the selection, reliability, and accuracy of the data in question. The main language employed will be English, but the introduction, table of contents, definitions, general explanatory text, and a very complete index will be in English, French, German, and Italian. The tables will contain all available information of value concerning the physical properties and numerical characteristics of (*a*) pure substances, (*b*) mixtures of definite composition, (*c*) the more important classes of industrial materials, (*d*) many natural materials and products, and (*e*) selected data for certain bodies or systems, such as the earth and its main physical sub-divisions, the solar and stellar systems, and certain biological organisms, including man. Publications of the world in many languages have been combed for data, and much unpublished information has been collected. The scope of the tables is immense, and of an unprecedentedly comprehensive character. The main purpose of the tables is to take stock of our present quantitative knowledge of material things and to prepare in convenient form a critical digest of such knowledge. The tables will be issued in a series of volumes comprising a total of about 2,500 pages (10 in. by 7 in.), publication extending over about a year and a half. The first volume is now in the Press, and may be expected early this year. The published price will be from $60 to $75 for the set, but the trustees are reserving the privilege of purchasing, at the rate of $35 per set, whatever number of sets may be required to fill all advance subscriptions received by the National Research Council of America up to a definite fixed date, probably April 1st or May 1st, 1925, after which date the privilege will lapse—but the trustees and the National Research Council are anxious that all scientific men and women shall be given the opportunity of taking advantage of the lower rate. Accordingly (1) members of a recognised scientific, technical or engineering society, or (2) universities, research laboratories, libraries, Government departments, or the like, will shortly be given preferential facilities for purchasing sets at the lower figure.

The National Research Council will deal with such applications, but all orders placed in the ordinary way through the trade will be handled by the publishers at the higher figure. Correspondence with reference to the tables should be addressed to Dr. G. W. C. Kaye, National Physical Laboratory, Teddington, Middlesex.

Educational.—SOUTH AFRICANS' VISIT.—Thirty-two engineer students of Cape Town University arrived on December 30th to spend 7½ weeks in England. They are all between 17 and 22, and each is paying his own expenses, says the *Daily Mail*. The first two weeks will be spent in London, to be followed by a tour of the industrial towns, including Birmingham, Manchester, Wigan, and Sheffield. Professors and lecturers accompanying the party are: Prof. A. E. Snape (civil engineering), Prof. D. McMillan (mechanical engineering), Prof. Plant (commerce), Prof. J. Boyd (German), Mr. A. H. E. Rogers (lecturer, electrical engineering), and Dr. Barker (lecturer in chemistry).

Gold from Mercury.—According to *Science Service*, Prof. Miethe's experiment, which was reported to have resulted in the transmutation of mercury into gold, has been confirmed by his collaborator, Dr. H. Stammreich. About 1½ kg. of mercury was used in a mercury vapour lamp, which was operated for 197 hours at 12.6 amperes, 160-175 volts. The gold produced is said to have amounted to 32 millionths of one gramme. Commenting on the subject, Dr. R. A. Millikan said that traces of gold were almost always found in mercury, and Prof. W. D. Harkins said that the energy brought to bear on the atoms of mercury in Miethe's experiments was exceedingly small in comparison with the amounts used in all artificial disintegrations as yet accomplished; experts would not trust any reports of atomic disintegration unless pressures of millions of volts had been used and the most extreme precautions taken. On the other hand, Dr. Frederick Soddy, of Oxford University, has stated that such a transmutation is not only possible, but inevitable, unless our views of atomic structure are radically at fault.

Gale Damage.—During the recent heavy gales on the South Coast, Volk's Electric Railway, which runs from the Brighton Aquarium to Black Rock, suffered severe damage. Portions of the track were buried, whilst others were broken, and a large hole was washed out at the rear of the electric car sheds.

Electricity Supply Undertakings.—As we are going to press we have received from the Electricity Commission the long-expected "Return of Authorised Undertakers in Great Britain, with Administrative Particulars of the Undertakings at December 31st, 1923." This is a volume of 378 pages, and may be obtained from H.M. Stationery Office, price 10s. net (plus postage). A review of its contents will appear later. In view of the magnitude of the work, it is probable that it will be re-issued only at considerable intervals, but we understand that the Electricity Commissioners have under consideration the advisability of issuing supplementary returns from time to time, to keep the particulars up to date.

The Return contains a mass of detailed information with regard to the supply undertakings, electricity districts, bulk supplies, and areas for which powers have been granted in England, Wales, and Scotland, and will be an invaluable work of reference.

The Register of Electrical Contractors.—We have received from the Secretary of the National Register of Electrical Installation Contractors (1, Lincoln's Inn Fields, London, W.C.2), a copy of the printed official list of installation contractors who had been entered on the Register up to November 30th, 1924. In the ELECTRICAL REVIEW for July 25th last we stated that the number then actually on the Register was 500. The list now before us includes well over 600 names.

Extensions at Stoke Newington.—Referring to the note on p. 983 of our issue of December 26th, we are informed by Messrs. Bruce Peebles & Co., Ltd., that since the extensions which we described were made, they have supplied and put into commission the two 1,000-kW motor converters for which space was provided in the works.

The Organisation of Technicians.—A public meeting of engineers, under the auspices of the National Council of Technical Staff Associations, is to be held in the Geographical Hall, Deansgate, Manchester, on January 15th. The Right Hon. J. R. Clynes, M.P., in expressing his regret at his inability to be present, says:—"It is a matter for both regret and wonder that large numbers of men with special qualifications due to great industry and costly education are often so poorly remunerated for their valuable services."

Wembley, 1925.—The Electric House, of E.D.A., which became so famous during 1924 is likely to be broken up and removed in a few weeks now. This structure, well known to most people in the electrical industry, is of a substantial character, elaborately wired for electric lighting, heating and power, and only needs fittings and a little cleaning up to make a most useful and attractive stand for anybody undertaking an exhibit in connection with home requirements at Wembley in 1925. Full particulars can be obtained from E.D.A. Offices.

Institution Notes.

Institution of Electrical Engineers.—A.M.I.E.E. EXAMINATION.—The next examination will be held on April 2nd, 3rd and 4th. Candidates must be either students or graduates of the Institution, or have lodged with the secretary a duly completed form "E" for election as Associate Member. Entry forms for the examination, which must be completed and returned by February 1st, and particulars regarding election to membership of the Institution may be had on application to the secretary.

THE FARADAY LECTURE.—On Tuesday, January 6th, Dr. G. W. O. Howe, James Watt Professor of Electrical Engineering at the University of Glasgow, delivered his lecture on "World-Wide Radio-Telegraphy" before the North-Western Centre of the Institution. The lecturer traced the growth of radio-telegraphy from the experiments of Faraday into the properties of magnetic and electric fields, through the conception of electromagnetic waves by Clark Maxwell in the '60's, and their experimental realisation by Hertz in the '80's, to the early experiments in wireless telegraphy by Marconi. He explained the nature of electromagnetic waves, and the reasoning whereby Clark Maxwell was led to their conception. He then traced the development of the various methods of producing

and transmitting the waves, including the spark gap, the Poulsen arc, the thermionic valve, and the high-frequency generator, and explained briefly the methods employed for continuous-wave reception and the arrangements whereby messages could be sent and received simultaneously. Prof. Howe discussed the problem of the mysterious bending of the waves around the curvature of the earth, and the difference between day and night transmission. Nearly every explanation which had been put forward depended upon the supposed existence of a conducting stratum in the upper atmosphere—the so-called Heaviside layer—but wireless telegraphy was not the only branch of science which made such an assumption. Meteorologists also explained the variation of the earth's magnetism by imaginary currents flowing in such an atmospheric stratum. In conclusion, the lecturer discussed the use of reflectors for concentrating the radiated energy in a narrow beam directed towards the receiving station. The Post Office had recently signed contracts with the Marconi Co. for the erection of several such beam stations for communication with the Dominions.

Junior Institution of Engineers.—On January 2nd, Mr. W. Ringrose delivered a lecturette on "Modern Flour Milling Machinery." He gave a comprehensive account of the preparation of wheat, and described how the processes of milling were carried out progressively through the various floors of the mill. He said that the machines were usually driven from a line shaft so that if one had to be stopped, all would stop; the passage of the wheat from one machine to another being practically continuous, it was of no use for one machine to be working when the one in front was unable to function.

Our Personal Column.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

According to the *Morning Post*, Sir PHILIP DAWSON, M.P., was leaving London on Monday last for another tour of investigation in the Baltic States, Poland, and Germany. "He will undertake the completion of certain reports on hydro-electric, railway, forestry, and other projects which affect the expansion of British trade in those countries, with which he was unable to deal fully during his visit in October."

It is announced that Prof. G. T. MORGAN, Professor of Chemistry in the University of Birmingham, has been appointed superintendent of the new chemical research laboratory of the Department of Scientific and Industrial Research at Teddington.

Mr. A. H. STURDEE, works manager at the English Electric Co.'s works at Stafford, has resigned in order to accept the appointment of chief works manager with Messrs. Ruston and Hornsby, Ltd., Lincoln. On December 30th he was presented with a cabinet of silver cutlery, and Mrs. Sturdee with a ribbon bracelet in platinum and diamonds. Lieut.-Col. C. HARDIE, D.S.O., assistant general works manager, London, is taking over control of the Stafford works.

Mr. H. ADWICK, on leaving Messrs. Crompton & Co., Ltd., of Chelmsford, to take up an appointment at Birmingham, has been presented by the staff with a gold watch.

Mr. E. A. PEARMAN, traffic superintendent for the Sunderland District Tramways, Ltd., for the last 20 years, is leaving to enter into a business partnership at Eastbourne. Officials and employés of the Tramway Co. presented him with a gold chain, the presentation being made by Mr. C. Dinsdale.

The Dover Corporation Electricity Committee has recommended the payment of £150 to the borough electrical engineer, Mr. HARPUR, for work in connection with the installation of new plant.

Mr. B. J. D'RANE, the new general manager of the Pará Electric Railways & Lighting Co., Ltd., and of the Pará Gas Co., Ltd. (Caixa, 29, Pará, Brazil), took up his duties on October 1st, 1924.

The Lytham-St. Annes Council has appointed Mr. J. C. FAIRCHILD, acting electrical engineer and manager, in succession to the late Mr. J. H. Clothier, at a commencing salary of £550. Mr. T. MATTHEWS has been appointed assistant engineer at a salary of £286. The Council has also conferred a gratuity of £5 per week for three years upon Mr. Clothier's widow, to be discontinued at the Council's option in the event of altered circumstances.

Mr. E. GUDIN has been elected a director of the Telephone Co. of Pernambuco, and Mr. A. J. MEDLYCOTT has been appointed secretary.

Mr. FOLLETT HOLT has retired from the chairmanship and boards of the Pernambuco Tramways & Power Co. and the Telephone Co. of Pernambuco, and Mr. WILLIAM HIGGINS has been elected chairman of both companies.

Mr. H. L'ESTRANGE, late of Messrs. Berkeley & Young, has joined the sales staff of the Enterprise Manufacturing Co., Ltd.

Mr. HENRY TATTAM has resigned the secretaryship of the Pernambuco Tramways & Power Co., Ltd., and the Telephone Co. of Pernambuco, Ltd., and has been elected a director of both companies.. He has also been appointed London manager of the Pernambuco Tramways & Power Co. Mr. H. HARPER has been appointed secretary of this company.

Obituary.—SIR A. M. J. OGILVIE.—The funeral of Lt.-Col. Sir A. M. J. Ogilvie took place at Brookwood Cemetery on Tuesday, December 30th. Among those present were: Mr. Robert Ogilvie (brother), Sir Evelyn Murray (Secretary to the G.P.O.), Sir J. F. C. Snell, Sir Chas. Bright, Sir Alex. Roger, Sir Wm. Griffith, Col. Purves, Mr. G. F. Preston, Mr. F. Gill, Mr. S. J. Goddard, Mr. J. E. Kingsbury, and Mr. W. A. Valentine.

MR. A. POLLARD.—The death occurred recently of Mr. Albert Pollard, electrical engineer, of Eagle Street, Accrington, at the age of 47 years.

New Companies Registered.

Kilkee Electricity Supply Co., Ltd.—Public company. Registered in Dublin on December 18th. Capital, £5,000 in £1 shares. To carry on the business of an electricity company in all its branches. The first directors are:—J. Leydon, O'Curry Street, Kilkee; M. Haugh, Stella Maris Hotel, Kilkee; J. Walker, Victoria Hotel, Kilkee; and W. C. Doherty, West End, Kilkee. Secretary: B. Mescall. Registered office: The Power House, Church Road, Kilkee, Co. Clare.

Budleigh Salterton Electric Light and Power Co., Ltd. (202,827).—Private company. Registered January 2nd. Capital, £6,000 in £1 shares. To adopt an agreement with T. H. Thompson for the transfer to the company of a Special Order (known as the Budleigh Salterton Electricity Special Order, 1923) granted to the said T. H. Thompson for the generation and supply of electricity in Budleigh Salterton, Devon. The first directors are:—W. A. Dagworthy, 1, Bedford Place, Sidmouth, engineer; W. C. I. Dagworthy, 1, Bedford Place, Sidmouth, engineer; R. P. Griffin, "Glen Lyn," Vicarage Road, Sidmouth, company manager. No share qualification required. Remuneration as fixed by the company. Secretary: R. P. Griffin. Solicitor: F. G. Hill, Budleigh Salterton. Registered office: 1, Bedford Place, Sidmouth.

Official Returns of Electrical Companies.

Wireless Equipment, Ltd. (in liquidation). — H. H. Foster, of 805-6-9, Salisbury House, London Wall, E.C.2, ceased to act as receiver on December 22nd, 1924.

Norwood Wholesale Fittings Supply Co., Ltd.—C. Austin, of 29, Brunswick Mansions, Aldgate, E.C., was appointed receiver on December 11th, under powers contained in debentures authorised December 2nd, 1924.

General Electric Co., Ltd.—Satisfaction to the extent of £40,100 on December 1st, 1924, of debenture stock dated July 22nd, 1921, securing £3,500,000.

Oriental Telephone and Electric Co., Ltd.—Satisfaction to the further extent of £4,909 on December 16th, 1924, of debenture stock covered by trust deed dated June 28th, 1905, and a supplemental deed of acknowledgment dated June 12th, 1907, securing £200,000.

British Automobile Traction Co., Ltd.—Trust deed dated December 19th, 1924, to secure £250,000 debenture stock, charged on the company's undertaking and property, present and future, including uncalled capital. Trustees: Electrical and Industrial Investment Co., Ltd., 88, Kingsway, W.C. (An underwriting commission of 3½ per cent. on the nominal amount of the stock was paid to the British Electric Traction Co., Ltd., and Thomas Tilling, Ltd., as joint underwriters.)

City Notes.

Telephone Manufacturing Co., Ltd.

In a letter to the shareholders the directors state that it has been decided to make up the accounts to December 31st for 1924 and succeeding years, as the subsidiary companies' books close on this date. The accounts to May 31st last recorded a loss of about £55,000, due to various causes, the effects of which were accentuated by a shortage of working capital. By the limitation of further capital outlay and the exercise of economies the business was considerably improved, and it is anticipated that the final accounts will show that the loss sustained has been made good to a large extent.

General Electric Co.

The *Financial Times* reports that the General Electric Company (United States) announces that it will dispose of its holdings of the General Electric Bond and Share Company and will organise a new corporation with an authorised capital of 1,803,000 shares of no par value by transferring to the new corporation 300 shares of 6 per cent. cumulative preferred of the Bond and Share Company having a par value of $30,000 and 250,000 shares of common stock of the Bond and Share Company, being the entire Common stock, with a par value of $25,000,000, paying 8 per cent. to the new

corporation for consideration of this transfer. It will distribute shares to shareholders of the General Electric Company on the basis of share for share.

The A.E.G. — A meeting of the shareholders of the *Allgemeine Elektrizitäts Gesellschaft* is to be held in Berlin on January 22nd to consider a proposed re-organisation scheme. It is recommended by the directors that the ordinary share capital shall be altered from 1,200 million paper marks to 120 million gold marks, the 6 per cent. first preference capital of 250 million paper marks to 17½ million marks and the second preference capital of 250 million marks paper to 17½ million marks in shares and 1¼ million marks in certificates. For the year ended September 30th last 5 per cent. was paid to the ordinary shareholders, 6 per cent. on the first preference and 5 per cent. on the second preference.

Companies to be Struck off the Register.—The names of the undermentioned companies will be struck off the Register at the expiration of three months unless cause is shown to the contrary :—

Electric Transport Co., Ltd.
Ennig Electric Light & Power Co., Ltd.
Maxim Electrical Co., Ltd.
Portable Searchlight & Signalling Co., Ltd.
Woolcrow General Mechanical and Electrical Heating Engineering Co., Ltd.

Electrolytic Zinc Co. of Australasia, Ltd.—In compliance with Stock Exchange regulations, the company has advertised particulars of its constitution, &c. It was formed in 1916, in Victoria, as a proprietary company and was made a public company in 1920. Of the authorised capital of £3,000,000 in £1 shares, 2,600,000 shares have been issued and fully paid up. The company has also an authorised debenture capital of £1,000,000, of which £400,000 (8 per cent. interest) has been issued.

Stock Exchange Notices.—Dealings in the following have been specially allowed by the Committee under Rule 159 :—

Mersey Railway.—£34,362 (new) New first perpetual debenture stock (4 per cent.).
Brisbane Tramway Trust.—Stock and fully-paid Scrip for £1,500,000 5½ per cent. Inscribed Stock, 1944-1954.
British Insulated and Helsby Cables.—£184,598 5 per cent. Mortgage Debenture Stock.
Madras Electric Tramways (1904).—£130,000 5½ per cent. Debentures of £100 each, Nos. 1 to 1,300 (Registered).

Italian Companies.—The following companies have increased their capital :—Soc. An. Radio Itala, from 5,000,000 to 7,500,000 lire; Soc. Radio Audizione Circolare, from 100,000 to 1,500,000 lire; Soc. An. Radiofono, from 100,000 to 6,000,000 lire; Soc. An. Apparecchi Radiofonica, from 50,000 to 1,000,000 lire; and Soc. An. Radioaraldo, from 1,000,000 to 1,600,000 lire.

John Spencer & Sons, Ltd.—It is reported that the company finds that it is unable to provide for the repayment of the debentures, due this month, and the debenture holders are taking steps to appoint a receiver and manager. The position is due to the bad trade of recent years; the preference dividend was passed in 1923-24.

Anglo-American Telegraph Co., Ltd.—The final dividends for the year are as follows :—Ordinary consolidated stock, £1 10s. per cent., making £3 15s. per cent. for the year; preferred stock, £1 10s. per cent., making £6 per cent.; and £1 10s. per cent. upon the deferred stock (only dividend).

Bell Telephone Co. of Canada.—The *Financial Times* states that the company has in prospect arrangements for the refunding of $16,750,000 of bonds which mature on April 1st. At the same time, it is believed that the company will issue new bonds to the extent of from $3,250,000 to $8,000,000 to meet capital requirements for the current year.

Prospectus.—*Northampton Electric Light & Power Co., Ltd.*—We have received a copy of a prospectus issued by the company offering to present shareholders, in proportion to their existing holdings, 50,000 ordinary "B" shares of £1 each at 28s. per share. The new shares will rank for dividend for the year 1925 with the existing ordinary shares.

French Companies.—At a recent extraordinary meeting of the shareholders of the *Union d'Electricité* it was decided to contract a loan in the United States by the issue of bonds to the amount of 4,000,000 dollars. This step was induced by the present conditions of the French financial market.

The *Société de l'Energie Electrique Indo-Chinoise*, of Paris, recently invited applications for 10,000 new shares of 500 fr. which were offered at 650 fr. each.

Marconi International Marine Communication Co., Ltd.—The directors are making arrangements to pay off the whole of the 5½ per cent. first mortgage debentures on April 1st.

Spanish Company.—The *Compania Sevillana de Electricidad*, of Seville, recently invited applications for 20,000 new shares of 500 pesetas at the price of 525 pesetas each.

Crompton & Co., Ltd.—The directors have declared an interim dividend at the rate of 7 per cent. on the preference shares for the half-year to September 30th, 1924.

Stocks and Shares.

MONDAY EVENING.

THE first full business week of the Stock Exchange New Year finds markets exceedingly active. There is a lot of trade going on in most departments of the Stock Exchange. Investment and speculation alike are in high favour. In some few instances, *e.g.*, Mexican issues, the tendency is dull and heavy, but in the great majority of markets, the influence of buyers is decidedly dominant. In the circumstances, it is a little surprising that the new Armstrong Whitworth 6½ per cent. consolidated third debenture, which came out at 99½, should be hanging fire. The price is down to 1 discount, and, considering the nature of the security, the stock looks cheap. Underwriters were relieved of their responsibility, but it would appear as though some of the big applicants subscribed for more than they were anxious to secure, and, with a call pending, the stock is being pressed for sale in blocks, whereas investment demand absorbs smaller amounts. Other new issues, however, are mostly strong in price, and ready welcome awaits the appeals for capital that are expected to be made by the electricity supply companies in the early part of the coming spring.

Expectation of what the electricity supply companies are likely to pay in the way of dividend is keyed up to a high pitch. Last year, as reference to our tables will show, dividend advances were declared by the Charing Cross Company, Chelsea, Kensington, Metropolitan, St. James's, South London and Westminster Companies. We have discussed on several previous occasions the chances that there are of the 1924 dividends being raised. In the present situation there swirl various cross-currents, the measure of which cannot be taken by outsiders, and it will depend upon the view which the companies' directors adopt in regard to the new year, 1925, whether rates are increased or not. It may be taken as practically certain that the bumper dividends of 1923 will not be diminished in respect of the year just ended.

Newcastle-on-Tyne ordinary have gone back to 1 1-16, this being the solitary change in the list of electricity supply shares. Midland Counties Electric are firm at 22s. 6d., and are regarded by some people in the market as being amongst the cheapest of this class. There is wide scope for the company's expansion, and for the investor who is content to lock-up shares for future reference, Midland Counties ordinary make sound shares to mix with other good Industrials.

Home Railway stocks are inclined to be dull, Metropolitans and Districts both giving way a little. Underground Electric ordinary shares are also easier at 3, being ¼ down. The income bonds, however, remain at 100. With the rise in the value of the pound sterling as compared with that of the dollar, the day is brought nearer when these income bonds are likely to be repaid, as it has been assumed, for some time past, that the company intended. Up to the present, however, the expense of redeeming the bonds, which can be presented in New York at the exchange of the day, has militated against their being dealt with in a scheme whereby the whole capital of the company could be put on a re-organised basis. Each rise in the pound sterling tends to increase, however, the probability of such an operation being carried out.

Marconis are a better market at 1¼, and Marconi Marines have strengthened to 22s. 6d. There has been another violent rise in Radio Corporations, the common soaring to 13¼, and, although the top price was not entirely held, the shares still show a substantial rise on the week. According to American advices, a lively gamble is going on in the shares in New York, Wall Street being most unusually busy and enjoying a boom, besides, in its railroad and industrial shares. American railroads, it may be remarked incidentally, afford very modest yields on the money, though if the exchange rises to parity again, one of the effects will be the re-establishment of a close arbitrage business between Wall Street and Throgmorton Street.

Cable stocks are steady, and no changes have occurred in either the Anglo-American or the Eastern groups.

Anglo-Argentine Tramways 5 per cent. debenture stock, with a rise of 3, has advanced to 75¼, and the yield is still the satisfactory one of 6¾ per cent. on the money. British Columbia Electric deferred stock shows a gain of 2, reflecting the confidence induced by the speech of the Chairman at the recent meeting. Mexicans continue heavy, and the market seems to be once more plunged into stagnation. Mexico Tramways 5 per cent. bonds, quoted nominally at 71 middle, changed hands at 69¾ last Friday.

Babcock & Wilcox are again better at 53s., and manufacturing shares all round exhibit decided strength. British Aluminium are 3s. up at 32s. 3d. Callenders have risen ¼, and Henleys at £3 are 1/16 higher. Siemens added a shilling to their price at 24s. 3d. English Electrics are a trifle harder at 19s. 3d. In General Electrics no alteration has taken place.

The rubber share market is decidedly good. Thanks to a shake-out in tea shares, due to apprehensions aroused by the Food Commission appointed by the Government, money is being turned out of tea, and diverted into rubber, with the consequence that prices amongst the latter shares are mounting day by day. There is, moreover, a substantial business doing in rubber shares, as, indeed, is the case with nearly all the Industrial sections which go to make up the Miscellaneous Market of the Stock Exchange.

Share List of Electrical Companies.

HOME ELECTRICITY COMPANIES.

	Nom. £	Dividend. 1923.	Dividend. 1924.	Price Jan. 5, 1924.	Rise or fall.	Yield. p.c.
Brompton Ordinary	1	12	10	1⅞	—	*£5 6 8
Charing Cross Ordinary	1	14	14½	2⅛	—	6 7 2
do. do. do. 4½ Pref.	1	4½	4½	17/6	—	5 2 10
Chelsea	1	10	12	37/6	—	6 8 0
City of London	1	15	15	47/6	—	6 6 4
do. do. 6 % Pref. ...	1	6	6	29/6	—	5 2 2
County of London	1	10	15	52/6	—	5 14 1
do. do. 6 % Pref. ...	1	6	6	23/6	—	5 2 2
Edmundson's Ordinary	1	7	7	22/-		... ...
do. 7 % Pref.	1	6	6	21/6	—	6 4 5
Kensington Ordinary	5	12	14	10⅝	—	6 10 3
London Electric	1	10	10	33/6	—	5 19 6
do. do. 6 % Pref. ...	5	6	6	5½	—	5 4 7
Metropolitan	1	8½	10	1⅞	—	5 6 8
do. 4½ % Pref.	1	4½	4½	17/6	—	5 2 10
Newcastle-on-Tyne Ordinary ...	1	2½	6	1 1/16	— 1/16	5 18 0
do. 5 % Pref. ...	1	5	5	18/0	—	5 5 8
do. 7 % Pref. ...	1	7	7	26/-	—	5 12 0
Notting Hill 6 % Pref.	10	6	6	9½	—	6 4 5
North Met. Elec. 6 % Pref. ...	1	6	6	1½	—	5 6 8
Urban Ordinary	1	—	4	19/3	—	4 4 8
do 6 % Pref. ...	1	5	6	19/6	—	6 3 1
St. James' and Pall Mall ...	5	14½	17½	12⅝	—	6 16 0
South London	1	11	15	2½	—	6 13 4
South Metropolitan Pref. ...		7	7	1½	—	5 12 0
Westminster Ordinary	5	12	15	11	—	6 16 4
Whitehall Elec. Invst. 7½ % Pref.	1	7½	7½	19/6	—	7 13 8

HOME RAILS.

Central London Ord. Assented	Stock	4	4	74	—	5 8 1
Metropolitan	,,	3½	4	8¼	− 1	4 17 5
do. District	,,	3	3½	55½	— ½	6 6 0
Underground Electric Ordinary	10	Nil	Nil	3	— ½	Nil
do. do. "A" ...	1	Nil	Nil	9/6	—	Nil
do. do. Income	Bonds	5	6	100	—	*6 0 0

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	Stock	6	6	104½	—	5 14 10
do. Def.	,,	1½	1½	24½	—	6 2 5
Chili Telephone	5	6	6	5⅝	—	*5 2 2
Cuba Sub. Ord.	10	7	7	7	—	10 0 0
Eastern Extension...	10	10	10	17	—	*5 17 8
Eastern Tel. Ord.	Stock	10	10	172½	—	*5 16 0
Globe Tel. and T. Ord.	10	10	10	17½	—	*5 16 0
do. do. Pref.	10	6	6	11½	—	5 7 10
Great Northern Tel.	10	24	22	20½	—	7 9 2
Indo-European	25	7	7	22½	—	*5 6 1
Marconi	1	15	10	1⅝	+ 1/16	6 3 0
Oriental Telephone Ord.... ...	1	12	12	1⅝	—	*6 8 0
United R. Plate Tel.	5	8	8	6⅛	—	*5 15 5
Western Telegraph		10	10	17	—	5 17 8

HOME AND FOREIGN TRAMS, &c.

Anglo-Arg. Trams First Pref....	5	12½	5½	5⅛xd	—	8 12 6
do. do. 2nd Pref. ...	5	5½	6	2¾xd	—	10 6 8
do. do. 5% Deb. ...	Stock	5	5	75½	+3	6 12 5
British Electric Traction Ord....	,,	5	5	99½	—	5 0 6
do. do 6% Pref.	,,	6	6	105½	—	5 13 9
Brazil Traction	100	4	4	58	—	6 18 0
Brit. Columbia Elec. Rly. Pcs.	Stock	5	5	88½	—	5 13 0
do. do. Preferred ...	,,	5	90/-	89½	—	*5 7 6
do. do. Deferred ...	,,	8	120/5	113½	+2	*5 14 0
do. do. Deb. ...	,,	4½	4½	80½	—	5 5 7
Lond. & Sub. Trac. 5 % Pref. ...	1	5	5½	6/6	—	7 13 10
London United Tram. Deb. ...	Stock	4	4	53½	—	7 4 1
Mexico Trams. 5% Bonds ...	—	Nil	5	71	−1	7 0 10
do 6% Bonds ...	—	Nil	Nil	86	—	Nil
Mexican Light Common ...	100	Nil	Nil	24	—	Nil
do. Pref.	100	Nil	Nil	52½	—	Nil
do. 1st Bonds ...	—	5	5	66	—	7 11 6

MANUFACTURING COMPANIES.

Babcock & Wilcox...	1	20	13	53/-	+¼d.	*4 10 9
British Aluminium Ord.... ...	1	5	5	32/3	+3/-	3 2 0
British Insulated Ord. ...	1	15	15	3	—	5 0 0
Callenders	1	15	15	2 1/16	+ ⅛	5 2 0
do. 6½ Pref....	1	6½	6½	23/9xd	+6d.	5 9 5
Crompton Ord.	1	5	Nil	10/-	—	... ...
Edison-Swan	4/-	7½	10	5/9	—	6 12 0
,, 5% Deb.	Stock	5	5	81½	—	6 0 3
Electric Construction	1	10	10	1⅝	—	6 3 0
English Electric	1	8	5	19/3	+3d.	5 4 0
do. do. Pref.	1	6	6	21/-	—	5 14 3
Gen. Elec. Pref.	1	6½	6½	23/3	—	5 11 10
do. Ord.	1	5	5	21/6	£	4 13 0
Henley	1	15	15	3	+ 1/16	5 0 0
do. 4½ Pref.	5	4½	4½	4½	—	5 6 0
India-Rubber	1	10	5	17/6	—	*5 14 3
Met.-Vickers Pref....	2	8	8	9½	—	6 8 0
Siemens Ord.	1	5	—	24/3	+1/-	4 2 6
Telegraph Construction	12	20	20	26½	—	*4 10 6

*Dividends paid free of Income Tax.

Market Quotations for Chemicals and Metals.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances

CHEMICALS, &c.	Price Jan. 6.	Fortnight's Inc. or dec.
a Acid, Oxalic ... ... per lb.	3¾d.	...
a Ammoniac, Sal ... ... per ton	£60	...
a Ammonia, Muriate (large crystal) ,,	£52	...
a Bisulphide of Carbon ... ... ,,	...	...
a Borax ... ... ,,	£25	...
a Copper Sulphate ... ... ,,	£25 10s.	...
a Potash, Chlorate ... ... per lb.	4d. to 4¼d.	...
a ,, Perchlorate ... ... ,,	5½d.	1d. inc.
a Shellac ... ... per cwt.	£15 15s.	...
a Sulphur, Sublimed Flowers ... ,,	£7 15s.	...
a ,, Roll ... ... ,,	£7 15s.	...
a Soda, Chlorate ... ... per lb.	3d.	...
a ,, Crystals ... ... per ton	£5 to £5 5s.	...
a Sodium Bichromate, casks ... per lb.	4d.	½d. dec.
METALS, &c.		
b Aluminium, Ingots ... ... per ton	£120 to £125	...
b ,, Wire ... ... per lb.	1/9 to 2/6*	...
b ,, Sheet ... ... ,,	1/6 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—		
Grade I ... ... per ton net	£252	£11 inc.
Grade II ... ... ,, ,,	£182	£8 inc.
Grade III ... ... ,, ,,	£104	£4 inc.
c Brass (rolled metal 2" to 12" basis) per lb.	10¾d.	1½d. to 2½d. dec.
c ,, Tubes (solid drawn) ... ,,	1/0¾ to 1/0½	¼d. inc.
c ,, Wire, basis ... ... ,,	10¾d.	¼d. inc.
c Copper Tubes (solid drawn) ... ,,	1/1½	...
c ,, Bars (best selected) ... per ton	£97	£1 inc.
c ,, Sheet ... ... ,,	£97	£1 inc.
c ,, Rod ... ... ,,	£97	£1 inc.
d ,, (Electrolytic) Bars ... ,,	£73 5s.	10/- inc.
d ,, ,, Sheets ... ,,	£143 10s.	...
d ,, ,, Wire Rods ... ,,	£82 5s.	25/- inc.
d ,, ,, H.C. Wire per lb.	10¾d.	¼d. inc.
f Ebonite Rod ... ... ,,	2/- to 3/6	...
f Sheet ... ... ,,	2/- to 3/6	...
n German Silver Wire ... ... ,,	2/3	...
h Gutta-percha, fine ... ... ,,	9/-	...
h India-rubber, Para fine ... ... ,,	1/7½	½d. dec.
l Iron Pig (Cleveland Warrants) ... per ton.	£5 2s. to £5 2s. 6d.	...
l ,, Wire, galv. No. 8, P.O. qual.	£25	...
g Lead, English Pig ... ... ,,	£44 15s.	15/- inc.
g Mercury ... ... per bot.	£14 5s. to £14 10s.	3/- to 3/6 inc.
e Mica (in original cases) small ... per lb.	9d. to 1/-	...
e ,, ,, medium ,,	4/- to 8/-	...
e ,, ,, large ... ,,	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings ,,	1/3½	...
p ,, ,, drawn bars & rods ,,	1/3	...
p ,, ,, rolled strip & sheet ,,	1/3½	...
p ,, ,, wire ... ... ,,	1/4½	½d. inc.
o Platinum ... ... per oz.	£28	...
d Silicium Bronze Wire ... ... per lb.	1/0½	...
r Steel, Magnet, in bars ... ... ,,	8d.	...
n Tin, Block (English) ... ... per ton.	£274 10s. to £275	£8 inc.
n ,, Wire, Nos. 1 to 16 ... ... per lb.	2/11	...

*For 1 cwt. lots. Special quotations against definite specifications.

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
l Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

An International Language.—According to Mr. A. Fanti, of the U.S. Bureau of Standards, the advent of "radio" has made an international auxiliary language a necessity; he therefore sends us a pamphlet on radio translated into "Interlingua," which is described as "modernised and simplified Latin, without inflection," and has been evolved by the Academia pro Interlingua, of Cavoretto, Turin, Italy. The following extract from the description of damped waves illustrates the style of the text:—

"Nos habe monstrato quod radio-undas consiste de undas de aethere que habe electrostatico et electromagnetico lineas de fortia; et descripto methodo pro produc undas attenuato de isto charactere. Isto undas procede trans spatio et illos es detecto per apparatu speciale."

It will be seen that "Interlingua" is quite easily read. Copies of the pamphlet can be obtained from Mr. Fanti, at the Bureau of Standards, Washington, D.C.

The Canadian Electricity Supply Industry.—An official review of the progress of the electricity supply industry in Canada during 1923 showa that the number of power plants increased by 10 to 532. All of these were fuel stations, the total at the end of 1923 being 263. The number of hydro-electric plants remained stationary at 269. The latter were extended, however, by the addition of 170,258 h.p. of plant, bringing the total capacity up to 2,282,547 h.p. The importance of the hydro-electric industry is very apparent when it is seen that the capacity of all other stations amounted to only 141,298 h.p. The amount of generating plant installed rose from 1,736,199 to 1,861,845 kVA. there being a decrease in the amount of d.c. plant in use. The total output during the year was 8,094,335,000 kWh, as compared with 6,740,750,000 kWh in 1922. About 900 miles were added to overhead lines during 1923, the total length at the end of the year being 23,560 miles.

Boiler-Room Practice.

Balancing Boiler-Room Heat.

By JOHN BRUCE, A.M.I.E.E.

(*Continued from page* 32.)

It will be noted from an examination of the losses detailed in the foregoing tables that the most variable, and the one which can readily reach very serious proportions, is that due to the presence of excess air in the gaseous products of combustion. It may be thought that in the following discussion the writer is unnecessarily stressing the seriousness of excess air. Excess air is a loss almost entirely influenced by methods of operation, and its reduction to and maintenance at a minimum entails the expenditure and application, at least in the majority of cases, of little more than sound common sense. A study of the amount of coal annually consumed in this country for purposes of steam generation, and an estimation of the average combined efficiency of the boiler plants concerned, forcibly emphasises the enormous annual loss of coal from this source.

Automatic stoker plant in first-class condition can in many cases be operated under conditions of commercial load with from 35.00 per cent. to 40.00 per cent. excess air. Assuming this to be so for the case under consideration, and that the other losses remain constant at the values stated, all excess air above 40.00 per cent. represents the incurring of preventable losses in the operation of the plant. How serious the loss due to excess air can be will be noted from the curves in fig. 2. These show for the range of excess air values and final flue gas temperatures, the losses per pound of coal consumed, incurred by operating the plant at air conditions in excess of 40.00 per cent. The losses expressed in fig. 2 are, or ought to be, entirely avoidable. To commercial or non-technical people the full significance of what this excess air loss means on the coal bill may not be entirely clear from the curves, but expressed in terms of money it brings the matter home very forcibly.

For example, assume that the boiler plant under consideration in the preceding section of this article consumes 10,000 tons of coal per annum, the cost of coal being £1 per ton. The preventable loss expressed in terms of £ s. d. due to excess air alone and assuming 40.00 per cent. excess air as the standard of operation, is then for the various values of excess air and final flue gas temperature, as set out in Table XI:—

2. The loss due to the heat carried away by the excess air drawn through the fuel bed. This loss can be reduced to a certain value dependent upon the critical

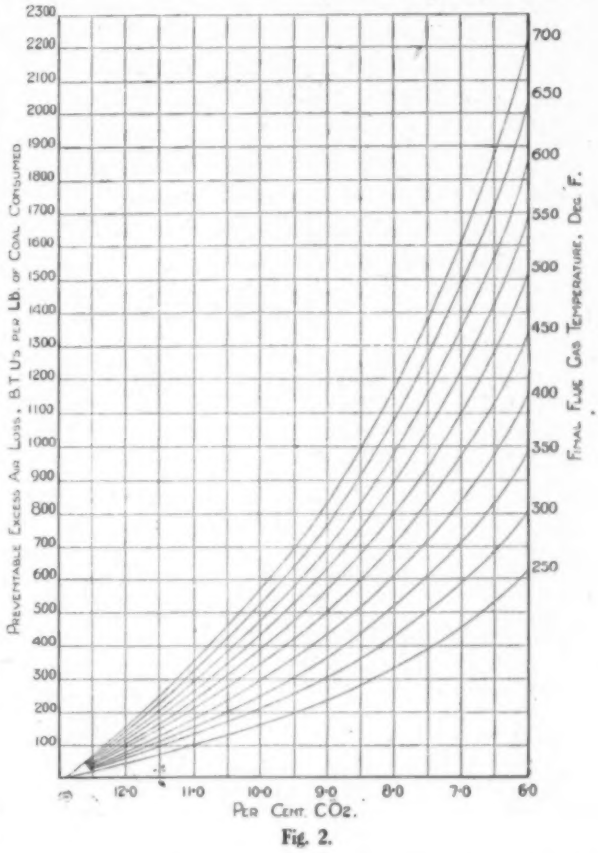

Fig. 2.

point of combustion for that particular stoker equipment and setting and the class and quality of the coal consumed. Under the best conditions of modern mechanical stoker practice, efficient combustion should be maintained with from 35.00 to 40.00 per cent. of excess air.

TABLE XI.—PREVENTABLE EXCESS AIR LOSS, EXPRESSED IN TERMS OF MONEY, ASSUMING 40·0 PER CENT. EXCESS AIR AS STANDARD OF OPERATION.

Temp. of Gases, Deg. F.	Per Cent. Excess Air. 60%	80%	100%	120%	140%	160%	180%	200%
250	74	147	221	295	368	442	516	590
300	94	189	284	378	472	566	660	755
350	114	229	344	458	572	686	800	915
400	134	269	404	538	673	807	941	1075
450	154	310	466	622	777	932	1087	1243
500	175	352	528	704	881	1058	1235	1412
550	196	393	590	787	983	1179	1375	1572
600	217	433	649	866	1082	1299	1515	1730
650	238	475	713	950	1187	1423	1660	1897
700	259	516	774	1031	1288	1545	1802	2059

From what has been said, it is seen that practically the greatest loss incurred in boiler plant operation is by way of the dry flue gases, principally due to excess air. When reporting this item in a heat balance statement, i.e., under the heading "heat carried away in the dry flue gases," it is usually calculated and set down as a total quantity. Actually the loss is the sum of three components. These three components are:—

1. The loss due to the heat carried away in the gases resulting from the theoretical combustion of the actual fuel. Beyond maintaining the final flue gas temperature at as low a value as possible, this loss cannot be reduced.

3. The loss due to the heat carried away by that portion of the total excess air due to leakage and infiltration through the stoker, boiler, and economiser settings. This loss, in many boiler plants the most serious component of the excess air loss, can be almost entirely eliminated by the institution of a regular system of vigilant inspection and gas testing at points in the gas circuit from furnace to stack on each boiler unit.

The indications or record of the ordinary CO_2 instru-

ment will give an approximate idea of the total percentage leakage up to the point in the gas path to which the instrument is connected. On a boiler unit consisting of boiler and economiser, a CO_2 indicator or recorder connected to a point in the gas path at the boiler uptake, a very usual point, *i.e.*, between boiler and first gas path or economiser, will only give information regarding the total percentage leakage of air through the fire bed and boiler setting, and will give no information as to the extent of leakage through the setting of the economiser. A CO_2 instrument connected to a point in the gas circuit at the economiser exit gives the necessary information from which can be approximately estimated the total percentage air leakage of the complete boiler unit. An instrument connected to such a point, however, is of very little use to the furnace operator as an aid towards the maintenance of efficient combustion. In fact, the information obtained from the instrument is of too general a nature to be of much use either as a guide to furnace conditions or air supply and air leakage. The per cent. excess air drawn through the fire bed, which is the component over which the stoker operator has direct control, can only be reasonably estimated from CO_2 indications if the instrument is connected to a point in the gas circuit as close to the furnace as possible, care being taken, of course, that the point chosen is sufficiently distant to ensure that complete combustion will be effected before the gases reach that point. In all gas sampling work it is hardly necessary to add that care must be taken to ensure that the sample of gas drawn for analysis is representative of all the gas produced.

The estimation of the total heat loss in the dry flue gas can only be made from an analysis of the gases and a knowledge of their temperature at the economiser exit, that is, immediately after they have left the last of the heat recuperative surfaces of the boiler unit. One of the best methods of determining the extent of air leakage through the setting of a unit is by providing test holes at the principal points of the gas circuit, *e.g.*, end of first pass, end of second pass, end of third pass, economiser gas inlet, and economiser gas outlet, and instituting a system for regularly testing, by means of an Orsat gas analysing apparatus, samples of the flue gases drawn from these points. The estimation of the CO_2 content alone will give quite reliable indications of the air leakages, but it may also be desired to estimate the losses incurred. For this purpose a portable pyrometer will be required in addition to the Orsat apparatus, and as previously stated, a knowledge of the composition of the coal consumed is also necessary. For example, assume that a test such as described has been carried out on a boiler unit provided with test holes for the purpose and that the following readings have been obtained:—

	CO_2	O_2	N_2, &c.	Temp. deg. F.	Approx. % of excess air.
At end of 1st gas pass ...	13.0	6.0	81.0	1,400	40.0
At end of 2nd gas pass	12.5	6.5	81.0	900	50.0
At end of 3rd gas pass ...	9.0	10.5	80.5	700	100.0
At economiser inlet ...	8.0	11.6	80.4	650	120.0
At economiser outlet ...	7.5	12.3	80.2	450	140.0

The above series of observations shows that a CO_2 instrument connected to the gas circuit at the economiser outlet could be very misleading as a guide to the condition of the furnace. The actual state of affairs, judged from the above tabulated readings, are that the furnace conditions are very good, but that excessive air leakage is taking place through the setting at the third gas pass and onwards to the economiser. For the next step in the estimation of the actual heat losses involved, we will assume the coal as fired, corrected for carbon in ash, &c., to have a composition of 0.68 carbon and 0.044 hydrogen. The theoretical air required is then approximately 9.3 lb. of air per lb. of coal. The actual air supplied, assuming no extra infiltration between fire bed and the first gas pass test point, is calculated as follows:—

Let w = Dry gas produced, lb. per lb. of carbon,

$$\text{then } w = \frac{11\ CO_2 + 8\ O_2 + 7\ (N_2 + CO)}{3\ (CO_2 + CO)}.$$

Substituting in this formula, the values of CO_2, O_2, and N_2, obtained from the analysis of the gas drawn from the first test point,

$$w = \frac{(11 \times 13.0) + (8 \times 6.0) + (7 \times 81.0)}{(3 \times 13.0)}$$

$$= 19.4 \text{ lb. of dry gas per lb. of carbon.}$$

Since only 0.68 lb. of carbon was involved in the combustion reactions per lb. of coal, the actual gas weight will be:—

$$19.4 \times 0.68$$

$$= 13.2 \text{ lb. of dry gas per lb. of coal.}$$

The actual air supplied for combustion equals the weight of the dry products of combustion plus the H_2O from the combustion of H_2 minus the weight of fuel in the gases, *i.e.*, for the case given:—

$$(13.2 + 0.396) - 0.724$$

$$= 12.872 \text{ lb. of air supplied per lb. of coal.}$$

Combustion has therefore been effected with:—

$$\frac{(12.872 - 9.3)}{9.3} \times 100$$

$$= 38.5 \text{ per cent. excess air.}$$

This could not very easily be improved upon, and represents very good stoker performance. The loss due to air infiltration is calculated as follows:—

Substituting in the previous formula the values of CO_2, O_2, and N_2, obtained from the analysis of the gas drawn from the test point at the economiser outlet:—

$$w = \frac{(11 \times 7.5) + (8 \times 12.3) + (7 \times 80.2)}{(3 \times 7.5)}$$

$$= 33 \text{ lb. of dry gas per lb. of carbon,}$$

and corrected to the carbon content of the coal under consideration:—

$$= 33 \times 0.68$$

$$= 22.44 \text{ lb. of dry gas per lb. of coal consumed.}$$

And the total air at this point:—

$$= (22.44 + 0.396) - 0.724$$

$$= 22.112 \text{ lb. of air per lb. of coal.}$$

The value of the component of the total excess air due to air infiltration through the setting of the complete unit:—

$$= 22.112 - 12.872$$

$$= 9.24 \text{ lb. of air per lb. of coal.}$$

With coal of 10,500 B.th.u. per lb. as fired and with a final flue gas temperature of 450 deg. F., and a boiler-room air temperature of 70 deg. F., the preventable loss of fuel is:—

$$= \frac{.24\ w\ (T - t)}{10{,}500} \times 100 \text{ per cent.}$$

$$= \frac{.24 \times 9.24 \times 380}{10{,}500} \times 100$$

$$= 8.00 \text{ per cent.}$$

With coal at £1 per ton, and taking for an example the plant previously considered, *i.e.*, with a coal consumption of 10,000 tons per annum, the preventable loss due to this component of the excess air alone equals £800 per annum. *(To be continued.)*

A Portable Cardiograph.—An experimental model of the first portable electro-cardiograph, used in studying the action of the heart, has been demonstrated at Schenectady, N.Y., U.S.A. The cardiograph itself is not new, but never before, it is said, has it been portable, nor has a device been commercially developed in which vacuum tubes are used for amplifying the heart voltages. Mr. L. T. Robinson, director of the general engineering laboratory of the General Electric Co., U.S.A., and Mr. H. B. Marvin developed the apparatus, and the demonstration was made at an open meeting of the Schenectady County Medical Association. Records of a patient's heart may be obtained now at the physician's consulting room or in the patient's home. Complete in its case, the apparatus weighs only 37 pounds, and in a second box, weighing 33 pounds, the power unit is carried; the portable cardiograph operates successfully despite ordinary vibration, and contacts can be made with simple metal straps, since the functioning of the instrument is not affected by skin resistance. Delicate preparatory adjustments are no longer necessary, and the fragile metal-quartz thread of the string galvanometer is eliminated.

Tramways and Light Railways in 1923-24.

THE Ministry of Transport returns relating to tramways and light railways in Great Britain for the year ended December 31st, 1923, in the case of company undertakings, and March 31st, 1924, in the case of municipal systems* are available much earlier this year.

The statistics deal with 243 undertakings, of which 170 are owned by local authorities and 73 by companies. Three companies have disappeared from the list, *viz.*, the Lancaster and District Company, whose powers have been abrogated; the Luton (Lessee) Company, whose undertaking has been taken over by the Luton Corporation; and the Plymouth, Stonehouse and Devonport Company, whose system has been transferred to the Plymouth Corporation. Additions to the list are the Torquay Corporation (Babbacombe Cliff) undertaking and the Glasgow Subway, which has hitherto appeared in the railway returns, but has been acquired and is being electrified by the Glasgow Corporation. In addition to these undertakings 14 railless trolley undertakings are dealt with (13 local authorities and 1 company). Seventeen local authorities and one company did not exercise their powers in this respect.

The consolidated statistics show that a total route-mileage of 2,624 was in operation during the year, comparing with 2,598 miles in 1922-23. The bulk of this (2,599 miles) was electrically operated, and 1,563 miles was of standard gauge. The number of passengers carried increased by 94,773,673, or 2.18 per cent., to 4,443,326,581, and the car-mileage by 11,147,648, or 3.17 per cent., to 363,057,881. Of this last total 99.42 per cent. was "electric" car-miles—showing that non-electric tramways are now practically negligible. As compared with 1913-14 the number of passengers carried and the car-miles run show increases of 34.57 per cent. and 7.12 per cent. respectively. The quantity of electrical energy used was 675,329,155 kWh, an increase of 34,077,644 kWh, or 5.31 per cent. as compared with 1922-23. Thus the energy consumed per car-mile increased from 1.84 to 1.87 kWh; in 1913-14 the figure was 1.83 kWh. The average receipts per passenger decreased from 1.66d. in 1922-23 to 1.53d. in the year reviewed, the pre-war receipts being 1.05d. per passenger.

Turning to the amalgamated accounts, it is seen that the total capital expended upon tramway systems was, at the end of the respective periods of companies and municipalities, £92,218,557, an increase during the year of £3,128,053. This was divided as follows:—Municipal authorities, £71,341,947; companies, £20,876,610.

In order to make a fair comparison of the revenue account statistics it is necessary to exclude lessors' returns. It is seen that with this correction the gross working receipts amounted to £29,433,647, as compared with £31,264,141 in the preceding year, and £15,160,476 in 1913-14. The equivalent figures for working expenses were £22,847,092, £23,815,620, and £9,779,563. From these figures it will be observed that whereas in 1913-14 the ratio of working expenses to receipts was only 64.51 per cent., in 1922-23 it was 76.23 per cent., and in 1923-24 it rose to 77.74 per cent. The net receipts for 1923-24 were £6,586,615, and the addition of sundry amounts rendered £7,701,973 available for distribution (£8,059,692 in 1922-23). These sundry additions included aid to the extent of £244,378 taken from the rates, but against this £277,899 was contributed to rate relief from the gross profits. Other allocations of the last were:—Interest or dividends, £2,126,338; debt repayment and sinking funds, £1,733,533; rent and other charges, £306,596; reserve and renewal funds, £2,138,316; income tax, £472,577; other purposes, £352,545; leaving £294,169 to be carried forward.

Of the 170 undertakings owned by local authorities, 156 were earning income in 1923-24 (as against 157 in 1922-23), and in accordance with the usual practice the undertakings have been grouped in six classes according to results. In Class 1, which comprises undertakings which showed a balance after meeting all charges, there are 98 undertakings, an accession of five since the previous year. The net balance shown by these undertakings was £404,101 (as compared with £461,295 for 93 undertakings in 1922-23). There was also an increase in Class 2 undertakings, which were able to meet all charges but had to exceed the amount available in providing reserves. There were nine undertakings of this class, with a debtor balance of £42,600, as compared with seven with an excess expenditure of £10,676 in the preceding year. Class 3 undertakings are those which were able to meet interest and capital redemption charges but were unable to meet income tax and other appropriation charges in full. There were 11 of these with a debt of £17,056, as against 14 in 1922-23, with a debt of £45,150. There were 22 undertakings in Class 4, able to pay interest charges but nothing further, with a liability of £46,435. In 1922-23 there were 27 in this class with a liability of £62,695. In Class 5, undertakings unable to meet interest charges in full, there were five undertakings (£87,789 down), as compared with 10 (£58,106 down) in the previous year. The last class, which comprises undertakings with working expenses in excess of revenue, included 11 undertakings as against six in the preceding year, with total losses of £136,067 and £61,565 respectively.

An analysis of the receipts and expenditure per car mile for all undertakings in Great Britain shows that the gross receipts of local-authority undertakings fell from 20.99d. to 19.15d.; those of company undertakings from 22.83d. to 20.87d.; and as a whole from 21.32d. to 19.46d. At the same time the gross working expenditure per car-mile declined as follows:—Local authorities from 15.99d. to 14.92d.; companies from 17.44d. to 16.10d.; and all systems from 16.25d. to 15.13d. The net receipts thus showed a general decline of about 14.6 per cent., as compared with the preceding year, and in comparison with 1913-14, an increase of about 13.6 per cent.

The returns include, as usual, a fully detailed account of the capital expenditure, revenue, working expenditure, allocation of profits, &c., for each undertaking in operation. These form a useful work of reference but cannot be adequately reviewed. It may be remarked that the capital expended upon the principal undertakings now stands at the following figures:—London County Council, £16,497,850; Glasgow, £6,026,164; Manchester, £3,008,597; Birmingham, £2,982,318; Edinburgh, £2,808,663; Liverpool, £2,476,696; and the County of Middlesex, £2,023,206. Among the leading company undertakings are the London United Tramways, Ltd., £2,603,217; the Bristol Tramways & Carriage Co., Ltd., £2,132,310; and the Metropolitan Electric Tramways, Ltd., £2,056,422.

The analysis of traffic revenue and working expenses shows that so far as the local-authority undertakings were concerned the former varied from as little as 11.73d. per car-mile, in the case of the Croydon Corporation to as much as 27.25d. in the case of Morecambe Corporation. Working expenditure ranged from 10.69d. per car-mile (Kilmarnock), to 40.26d. (Barking). The ratio of expenses to receipts was at its highest for the last undertaking (141.45 per cent.), and at its lowest in the Birkenhead undertaking (63.49 per cent.) So far as the companies were concerned, the highest revenue per car mile was earned by the Great Orme system (107.9d.) and the lowest by the Gosport and Fareham system (11.04d.). As regarded expenses the highest level was reached by the Great Orme undertaking (90.6d. per car-mile) and the lowest level by the Aberdeen Suburban undertaking (10.8d.). The ratios of working expenses to revenue were:—Highest 143 per cent (Wolverton and Stoney Stratford); lowest 42 per cent. (Birmingham District).

The statistics relating to railless trolley vehicles are given separately, and details are available of 16 municipal undertakings and one company undertaking (Mexborough and Swinton). The aggregate expenditure upon the former is given as £302,243. The total revenue was £122,907, expenditure £111,707, and gross profit £11,200. The surplus was insufficient to cover all charges and the undertakings finished the year with an aggregate loss of £11,945. It is to be noted, however, that this balance is provided by only two undertakings. The charges of the others were apparently met from the funds of parent tramway systems. The company undertaking had a revenue of £5,563 and expenses amounting to £6,437—a gross loss of £874. The ratio of expenditure to receipts was generally very high, amounting to over 100 per cent. in five cases (including the company), while in four other cases it was over 90 per cent.

*Stationery Office, 15s. net.

Electromagnets for Loading Ships.—At a meeting of the North of England Steamship Owners' Association it was decided to investigate whether the use of electromagnets for loading and discharging ships' cargoes was advantageous or otherwise. Complaint has been made that the use of electromagnets has an effect upon the sub-permanent magnetism of a ship, which itself becomes a source of disturbance to the compass. It has also been suggested that the use of electromagnetic cranes creates grave and immediate disturbance of the ship's compass. On the other hand, it has been stated from another source that, owing to the handling of pieces of cargo in different positions, the magnetic influence is counterbalanced, and that the effect on the ship's compass has not been found to exceed that ordinarily encountered where magnets are not used. The Chamber of Shipping has asked for the views of members who have had experience of the use of electromagnets.

Ultra-violet Light in the Hen-run.—Writing to *Science* of December 12th, Messrs. J. S. Hughes and L. F. Payne state that ultra-violet light has a marked effect on the egg production of young hens. Experiments which they carried out last winter showed that in 16 weeks a dozen pullets treated with ultra-violet light for 10 minutes daily laid 497 eggs, whilst a dozen similar birds with the same food, but not treated, laid only 124 eggs. The eggs from the former contained more calcium and had twice the percentage "hatchability" of those produced under ordinary conditions. On reversing the conditions and radiating the hens not previously treated similar results were obtained.

A New Squirrel-Cage Motor.

Induction Type with High Starting Torque.

By T. F. WALL, D.Sc., D.Eng., A.M.I.E.E.

(*Abstract of paper read before the* SHEFFIELD SUB-CENTRE *of the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE paper describes a new method of providing a squirrel-cage motor with a high starting torque without necessitating a prohibitively large starting current in the line. The method developed by the author is considered to have advantages not possessed by any previous proposal. A number of test data have been obtained, which it is hoped may form the basis of the design of squirrel-cage rotors for any required practical conditions. The data in the paper have been obtained from an actual experimental motor of 57 b.h.p. built in accordance with the author's proposals by Messrs. J. H. Holmes & Co., and tested at their works in Newcastle-on-Tyne.

The essential features of the method proposed by the author were described in a preliminary paper read before Section G of the British Association at Liverpool in 1923. It is well known, from the theory of transformers, that when the secondary winding is short-circuited the effective resistance of the primary winding is given by the expression—

$$R_1 + \frac{M^2 R_2 \omega^2}{(L_2 \omega)^2 + R_2^2}$$

where R_1 = resistance of the primary winding, in ohms; R_2 = resistance of the secondary winding, in ohms; L_2 = inductance of the secondary winding, in henrys, and $\omega = 2\pi \times$ supply frequency. This expression shows that the resistance *increases* as the supply frequency increases. Further, the effective inductance of the primary winding when the secondary is short-circuited is given by the expression—

$$L_1 - \frac{L_2 M^2 \omega^2}{(L_2 \omega)^2 + R_2^2}$$

where L_1 = inductance of the primary winding. This expression shows that the effective inductance of the primary winding when the secondary is short-circuited *decreases* as the supply frequency increases.

Actually, each rotor bar is constructed as follows: A central copper core is surrounded by a steel sheath which may or may not be in electrical contact with the copper core. The sheath is covered with an outer copper skin brought into good electrical contact at each end with the central copper core. Such a composite conductor is, in effect, a simple form of auto-transformer with short-circuited secondary winding. The central copper core forms the primary winding, the steel sheath is the magnetic core, and the outer copper skin is the secondary winding.

If a squirrel-cage rotor is constructed with such composite bars, then (at starting) the frequency of the currents induced in the bars being of the full supply frequency, the effective resistance will be relatively high in accordance with the expression given above. When the rotor is running normally, the currents in the rotor bars will be of very low frequency corresponding to the rotor slip; consequently, the effective resistance of the composite bars will be correspondingly reduced, and will, in fact, be practically the same as that found by direct-current measurement.

The relative thicknesses of the central copper core, the steel sheath, and the outer copper skin, are of great importance in determining satisfactory performance. With an area of the outer copper skin of 10.3 mm.² the effective resistance with alternating current at 50 frequency *decreases* slightly with the current density, the average value being about three times the resistance as measured with direct current. Oscillograms of the p.d. and current waves for current densities of 17.6, 22.1, and 26.6 amperes per mm.² respectively show the power factor as a function of the current density, and the average value of the p.f. in this case is about 0.987.

With an area of the outer copper skin of 20.9 mm.² the effective resistance *increases* slightly with the current density, the average value for the range tested being about 2.5 times the resistance as measured with direct current. Oscillograms show the p.f. of the composite rod for current densities up to about 15 amperes per mm.² to be very close to unity.

With a composite rod comprising merely a central copper rod and a steel sheath (corresponding to the proposal of Elihu Thomson) the resistance decreases to a very marked degree with an increase of current density. That is to say, the rod has to some extent a negative resistance characteristic, which may result in an unstable condition so that the current may increase to an unduly large value. The average value of the power factor in this case is about 0.865, which appears to the author to be one of the chief reasons why the use of such composite conductors (*i.e.*, without any outer copper sheath) has not been found satisfactory.

In order to show the great significance of the power factor on the starting characteristics of the motor, the curves shown in fig. 1 have been calculated for the case of the motor for which the specification is given in the paper; they show the relationship between the starting torque and the ratio (Effective rotor resistance at starting)/(Normal rotor resistance when running). Curve I refers to the case in which the increased rotor resistance at starting is obtained by means of conductors which have unity power factor, and Curve II refers to the case in which the increased rotor resistance at starting is obtained by means of conductors having a power factor of 0.86. For a given effective rotor resistance at starting, the starting torque, when the p.f. is 0.86, is not much more than one-half the torque when the p.f. of the resistance is unity. This shows in a very striking way the importance of obtaining the increase of the starting resistance at as high a p.f. as possible.

The composite conductors with an outer copper skin have a further advantage over those without a skin, in that the p.f. of the former, when the rotor is running at normal speed, will be considerably greater than the p.f. of the conductors which have merely a steel sheath. The reason for

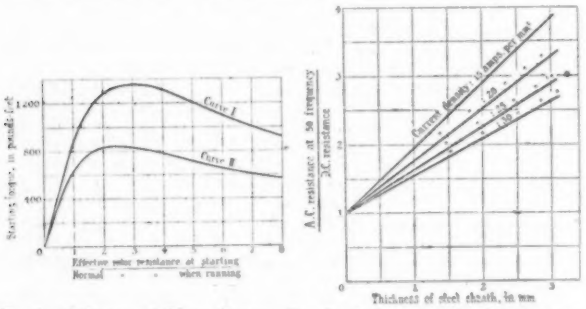

Fig. 1.—Influence of Power Factor.

Fig. 2.—Influence of Sheath Thickness.

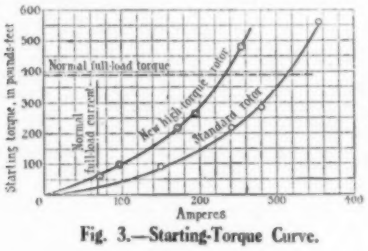

Fig. 3.—Starting-Torque Curve.

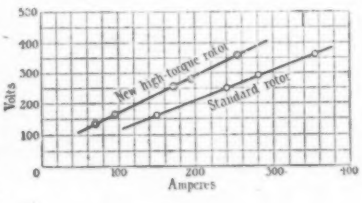

Fig. 4.—Short-Circuit Tests.

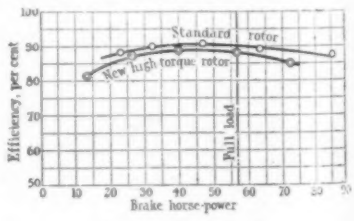

Fig. 5.—Efficiency Curves.

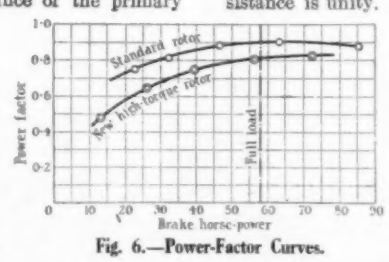

Fig. 6.—Power-Factor Curves.

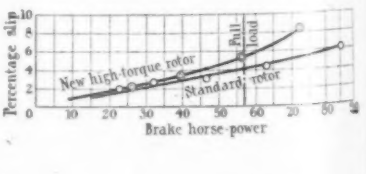

Fig. 7.—Percentage-Slip Curves.

this is that a large proportion of the current can flow through the outer copper skin and, in so far as the outer copper skin is concerned, the steel sheath has no effect on its inductance. A further important deduction that can be made from Curve I is that the maximum starting torque obtainable by increasing the rotor resistance is reached when the increased rotor resistance is only about three times the normal running resistance.

To ascertain the influence of the thickness of the steel sheath on the characteristics of the composite rod, resistance tests were made with three rods, each having a different thickness of steel sheath, and from the results the relationship between the thickness of the steel sheath and the ratio (a.c. resistance at 50 frequency)/(d.c. resistance) has been deduced and plotted in fig. 2. This relationship has been deduced for the following values of current density, *viz.*, 15, 20, 25 and 30 amperes per mm.² respectively. It is interesting to note that the a.c. resistance of the composite rod increases proportionally to the thickness of the steel sheath.

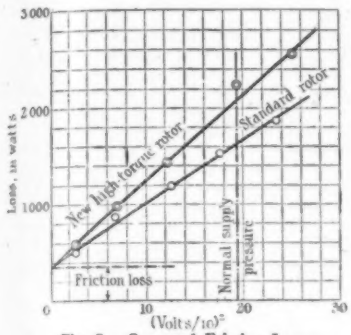

Fig. 8.—Core and Friction Losses.

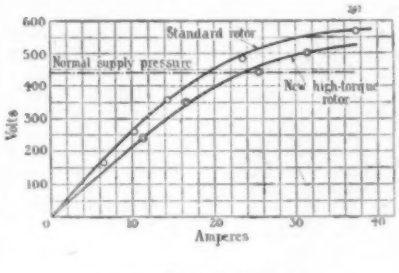

Fig. 9.—Magnetisation Curves.

A sample high-torque squirrel-cage rotor was constructed on the author's new principle, and tested in a standard stator; afterwards a standard squirrel-cage 57-b.h.p., 440-V, 40-cycle, 6-pole, synchronous-speed, 800-r.p.m. rotor was tested in the same stator, and the results are shown in figs. 3 to 9.

The diameter of the central copper rod was appreciably less than the internal diameter of the steel sheath, due to irregularities in the bore of the steel tube, which made it impossible to insert a copper rod of diameter larger than 0.236 in. If the bore of the steel tube could be obtained dead true, it would be possible to avoid the waste space inside the steel tube, and thus obtain a composite rod of lower resistance. In this way the efficiency of the motor would be improved without impairing the starting conditions.

It was not considered desirable to punch more than 60 slots in the rotor for the composite bars, since doing so would have rendered the minimum section of the teeth too small for mechanical strength.

The striking improvement in the starting conditions when the author's new high-torque rotor is used may be deduced from the curves in figs. 3 and 4. For instance, to obtain the full-load torque at starting, with the author's new type of rotor, a current of 230 amperes is necessary (fig. 3), and the applied voltage at the terminals will be 320 V (fig. 4). If an auto-transformer is used for starting, the line current will be $320/440 \times 230 = 167$ amperes, and since the normal full-load current is 68 amperes, the full-load starting torque is obtained with a line current of only 2.45 times the full-load current, whereas with the standard rotor, in order to obtain full-load starting torque the line current must be 3.37 times the full-load current.

Fig. 5 shows that the efficiency of the new type of rotor is slightly lower than that of the standard rotor, largely due to the fact that the central copper rods of the composite conductors did not quite fill all the space inside the steel sheaths, as already pointed out. This can be obviated in future and the efficiency at full load thus brought practically equal to that of the standard rotor.

Electric Pumping in Holland.

An Unusual Modern Installation.

A LARGE part of the Netherlands is below sea level, the *polders*, as the lower parts of the country are called, having been originally lakes or marshes that have been surrounded with dykes and reclaimed. The pumping installations used for drainage are distributed all over the country, and will soon eliminate the picturesque old windmills entirely from the landscape in Holland. Such pumping plant is in operation for a small number of days per annum (in one case 45 days is a fair average), but enormous quantities of water are dealt with, the capacity varying between 1,400 and 14,000 cu. ft. per minute per pump. The lift, however, is low, 16 ft. being about the highest, but, as a rule, lifts vary between 5 and 10 ft. Nowadays the centrifugal pumping-engines for such drainage work are driven by steam, Diesel engines, gas engines, or electricity, and their number and size are increasing gradually with the demand of agriculturists to keep the water in the canals and ditches strictly at the most favourable level for the crops.

An unusual electrically-driven installation is described in the *Transactions* of the Institution of Engineers and Shipbuilders in Scotland by Prof. J. C. Dijxhoorn, of the Technical University, Delft, Holland, who explains that in 1915 the Government of Groningen, a province to the east of Friesland on the frontier of Germany, decided that three pumps, each capable of dealing with 33,333 cu. ft. of water per minute, should be erected near the village of Zoutkamp on the Lauwer Zee, which is in open communication with the North Sea. The lift varies widely, but the capacity of the three pumps together will be 100,000 cu. ft. per minute when the lift does not exceed 4 ft. 3 in.; the mean lift may be taken at 3 ft. 9 in. It is intended to install two more pumping engines of the same capacity in the same building.

The Board of the province possesses its own electric power supply at Helpman, a suburb of the city of Groningen, situated about 18 miles from the pumping works, and a considerable consumption of electricity might be expected in this prosperous part of the country. Electricity was selected for the driving power, and the new *boezem* received the name "Electra." The great difference of lift, ranging from zero to 5 ft. 9 in., presented some difficulty in choosing the best pumps, but the author avoided the difficulty by the adoption of screw pumps. Such pumps for small lifts are constructed on the siphon system, and have proved very successful, especially in the district of New Orleans, where this system was introduced by Mr. A. B. Wood, mechanical and electrical engineer of the Sewerage and Water Board of that district. For very large capacities this system presented several advantages, one of fundamental importance being that, when working at a constant speed but with widely different lifts, the power required for driving a screw pump varies less than that for driving a centrifugal pump and the water is not liable to so many changes of direction. In the screw pump, fig. 1, the main flow of the water is axial only, with the result that smaller losses of head, caused by friction, whirling, &c., might be expected than with a centrifugal pump. For pumps working with very small lifts these losses represent a great percentage of the actual lift, and, consequently, a more favourable efficiency with screw pumps might be expected.

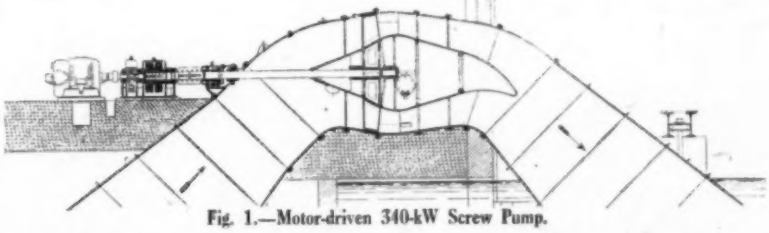

Fig. 1.—Motor-driven 340-kW Screw Pump.

The simpler form of the pump casing and of the adjoining pipes induces the designer to make all cross-sections of ample area, and there is no great difficulty in building units of much greater capacity than is possible with centrifugal pumps of reasonable dimensions. As a consequence a notable economy in the dimensions and cost of the building was thereby secured.

The pump as a whole is a siphon pipe; a horizontal section contains the working part of the screw pump, the adjoining inlet and discharge pipes being inclined at about 45 deg. The screw wheel is keyed to a horizontal shaft, and in the direction of the waterflow a circle of curved guide blades leads the water again in an exactly axial direction.

Only the outside ring section of the pump is active; the central part is hollow and double pear-shaped. The centre piece of the pump wheel is conical, in accordance with the adjoining centre piece of the pump itself. The bearings are lubricated from the outside; the inside diameter of the wheel at the discharge side is 11 ft. 7¾ in., and the conical suction-pipe is 12 ft. 9 in. diameter at the inlet opening and 9 ft. 10 in. diameter at the connection with the pump casing, the discharge widening to 13 ft. 2 in. at the immersed discharge mouth.

Fig. 2 gives a good impression of the size of one of the pumps as it stood in the erecting shop of the engineering

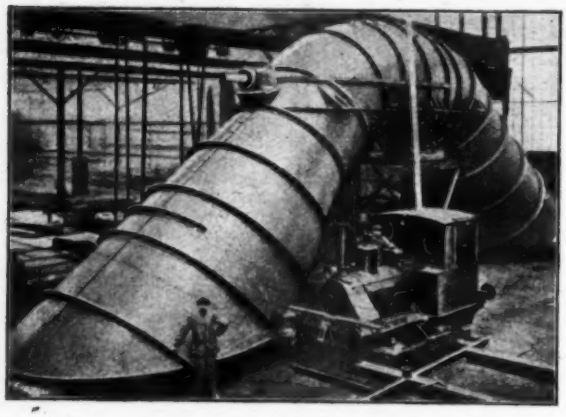

Fig. 2.—A 341-kW Screw Pump.

works of Messrs. Stork Bros., Hengelo. The diameter of the pump wheel is 141 in., and the end thrust on the pump shaft is taken by a Michell block fixed to the pump casing.

At normal load the three-phase 3,000-volt electric motor runs at 978 r.p.m., driving the pump shaft at 53 r.p.m. by a double gear. Forced lubrication for the bearings and the gearing is maintained by a pump driven by toothed gearing in the main gear casing. To start the main pumps, they are filled by evacuating the casing while starting the motor; the vacuum pumps are electrically driven, the screw pump first working at a quarter of the blade-wheel diameter, then at a half of this diameter, and so on, the load on the motor increasing gradually with increased evacuation. This is an advantage when using an electric drive, especially with a high-voltage and a long cable, sudden overloading of which is to be avoided. Each pump is provided with an emergency valve in order that air may be let in automatically; consequently, the pump will be emptied if the electric current should fail.

Under the conditions prevailing in 1918, the difficulties in completing an aerial line 18 miles in length from the power house to the pumping works were such that a cable of a smaller capacity was laid instead, and a provisional steam-plant was installed (for generating the electricity for driving at full power) on the site of the fourth and fifth pumps, to be erected later.

The hall containing the three pumps, fig. 3, gives an impression of extreme simplicity, considering that 100,000 cu. ft. of water passes through it each minute.

The results of the trials may be summarised as follows, the figures being the exact averages with lifts varying from 2 ft. 1¼ in. to 4 ft. 3¾ in. :—

Speed, r.p.m.	53.2
Mean lift, in.	44
Water discharged by each pump per minute, cu. ft.	35,564
Water h.p. developed by each pump	246.4
Mean kW for 1 pump motor	341
KW per water h.p.	1.38

Patents in Japan.—The Institute of Patentees informs us that it has been notified by the Consul-General of Japan that the date for the recovery of the registration of a patent, utility model, design, or trade mark, destroyed with the archives of the patent office of the Imperial Japanese Government in the earthquake and fire in September, 1923, has been extended to January 31st, 1925. Any inventors, therefore, who have not made application should do so immediately. A similar intimation appeared in our issue of November 21st, 1924.

Electrical Prospecting.

Detecting Hidden Ore-Bodies.

In an interesting paper read before the Chemical, Metallurgical and Mining Society of South Africa recently Mr. G. Bergstrom described developments in prospecting by electricity, and mentioned that a company had been formed to exploit the process. All the different patent rights are in one hand, said Mr. Bergstrom, and wonderful results have been obtained from the methods in different parts of the world. He added that such methods will soon be introduced in South Africa. *Inter alia*, according to the *S.A. Mining and Engineering Journal*, Mr. Bergstrom said :—

There are several different scientific principles which render it possible, theoretically at least, to detect certain kinds of hidden ore-bodies. All of them are based on some physical or chemical feature, distinguishing the ore from the surrounding rock. Bodies of magnetic ore (for example, magnetite) can be discovered and fairly closely studied by means of instruments in which the magnetic needle is utilised. Magnetic methods have been developed to a high degree of accuracy in Sweden and have rendered invaluable service.

In minerals which are not completely oxidised and subject to a slow continuous oxidisation, especially sulphides, but also lower oxides such as magnetite, the oxidisation and accompanying chemical reactions will, in most cases, set up a certain electrical potential around the ore-body, which is noticeable in a sensitive galvanometer. The ore-body and the rock surrounding it form a sort of galvanic battery. Certain results have been obtained by utilising this fact, for prospecting purposes, but the danger of errors is always considerable. Partly decomposed organic matter will cause similar potentials.

Among non-geological prospecting methods, the electrical methods are the most general and most promising. Their foundation is the fact that most metallic minerals are far better electric conductors than the surrounding rock. The use of earth currents has been tried for this purpose; either those caused by chemical reactions round the ore-bodies, or those caused by the earth's magnetic field; the results, however, have not been encouraging. Practical results have only been obtained by specially generating electric current, which is led into the ground. The distribution of such current is then studied in different ways and exceedingly useful information can thus be obtained. Prof. C. Schlumberger, at the Ecole des Mines in Paris, has used direct current for his comprehensive investigations with a great deal of success. When using d.c. great care has to be taken to avoid polarisation and all kinds of contact resistance might cause serious errors. For practical purposes alternating current is preferable, and from the distribution conclusions can be drawn as to the conductivity of the different components of the ground within the area under examination.

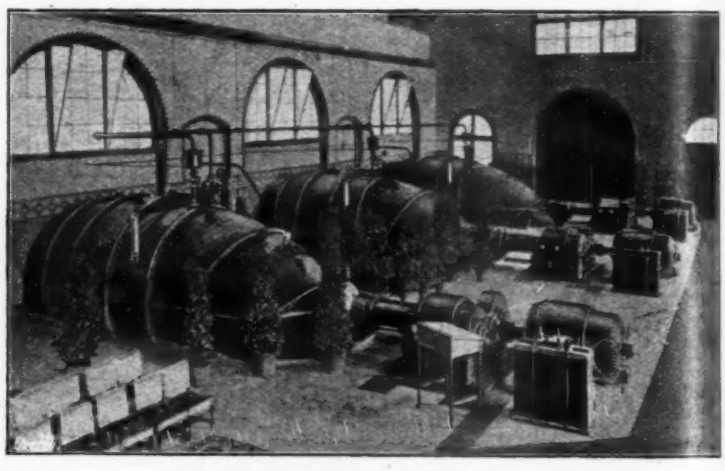

Fig. 3.—The "Electra" Pump House.

The problem reduces itself to finding some simple means of observing the directions the currents actually take. About 20 years ago two Englishmen, Messrs. Daft and Williams, invented an electrical prospecting method, the principle of which was direct observations of the current. However, the personal element influences the results to a large extent; it is rather difficult to differentiate between sounds of slightly different strength, and no two observers would get exactly the same results. On behalf of the Geological Survey of Sweden, Dr. Tegengren and the author investigated this method carefully and arrived at the conclusion that some more accurate and definite method of studying the electric field must be found to make electrical prospecting a practical proposition. They finally arrived at the equipotential line method, described in the year book No. 7 of the Geological Survey of Sweden, 1913.

The underlying principle is as follows :—Suppose that a.c.

is led down into the ground at two points. The currents travel, and supposing that at a given moment the drop in voltage from points B to B_1 is 100 volts, the same drop takes place along all the current lines. If one of these lines is followed a point will be found where the drop in voltage from P is, say, 25 volts. A similar point can be found on any other current line, and if all these points are connected with a line, a so-called equipotential line is found. With a certain position of the points P and P_1, the equipotential lines always remain where they are; in other words, the electric potentials of all the points on the same equipotential line always remain the same. This means that no current will pass from one point to another on the same equipotential line. For practical purposes we can assume that the equipotential lines always cross the current lines at an angle of 90 deg., and thus if the equipotential lines are known, the current lines are also known, and fortunately it is possible to find the equipotential lines in a very simple way by means of a telephone. Suppose the two rods with which the telephone is connected are pushed into the ground at two points. There will then probably be a difference in potential between the two points, and a buzzing sound will be heard in the 'phone. By moving one of the rods about, it is possible to make this sound weaker and weaker till it finally disappears. Both the rods are then placed on the same equipotential line, and by going on like that it is easy to find any number of points on the same line. In the same way any desired number of equipotential lines can be mapped out and a complete knowledge of the appearance of the electrical field in the ground obtained.

These methods have given striking practical results, and there is not the slightest doubt that a very valuable means has been put in the hands of mining people when it comes to discovering hidden ore-bodies. With a certain position of the points or lines in which the current is introduced into the earth a certain ore-body will deform the electric field in one defined way. Theoretically it should therefore be possible to draw conclusions not only about the position of the ore-body, but also about depth, size of the ore-body, &c. There are, however, many variables to be considered, and so far the only safe conclusions that can be drawn are that within the area under investigation there is, or there is not, something with a decidedly different electrical conductivity than that of the rest of the ground, and that the same something is situated there and there. The nature of the disturbances has to be found by diamond drilling, shaft-sinking, &c.

There exists to-day also a method by which it is possible to find the strongest currents without the aid of equipotential lines, the idea being to study by means of sensitive instruments the strength of the magnetic field at different points of the area under review. The strongest indications should be obtained at the points nearest to the ore.

The Bandon Hydro-Electric Undertaking.

Practical Water-Power Development in Ireland.

By J. MURPHY.

(Abstract of paper read before the INSTITUTION OF CIVIL ENGINEERS OF IRELAND.)

THE paper deals with the practical development of power from the Bandon river, and the experience gained may prove of value when combined with the available data of other undeveloped Irish rivers.

In May, 1919, the author was asked to advise on an electricity supply scheme for Bandon, Co. Cork, and experience obtained some years previously on another river in the same locality—the Flesk at Killarney—indicated the difficulties in the way of meeting the power and lighting demands of an Irish town from a river without water storage. The promoters were of opinion that auxiliary generating plant might not be necessary for the demand which they anticipated, but the author pointed out that while there was undoubtedly an excellent opening for an electricity supply undertaking, they should not be too optimistic about the water power available.

Owing to the occasional shortage of power, due to low water in summer and to flooding in winter, an auxiliary plant had to be considered. It was decided to install a moderate-sized internal combustion set with a storage battery, in preference to a larger engine without a storage battery, and after five years' experience with it the writer's opinion is that under similar conditions a battery is indispensable.

The plant installed includes:—Two vertical-shaft sets, each of 25 kW; one geared set of 20 kW; one old twin belt-driven set of 30 kW; a gas-engine set of 60 kW; and a 600-amp.-hour battery. The two-vertical shaft sets are the first turbines fitted with Lawaczeck high-speed propeller-type runners installed either in Great Britain or Ireland. The speed of the runners is 180 r.p.m. on the seven-foot fall, but I understand that at the present stage of the development of this type of runner this speed can now be materially increased.

One of the vertical sets is provided with an automatic voltage regulator. Variations of 2½ per cent. above or below normal station voltage tilts a balanced beam which causes one of two contactors to "make" the circuit to a small motor arranged to run in either direction; through a speed-reduction gear and by means of a chain, it operates the turbine-regulating gate. This voltage regulator, under our conditions, gives better service than a speed governor. With shunt-wound dynamos, such as are installed at Bandon, constant speed would not give constant voltage without shunt regulation, and compensating devices to give the characteristic change in speed to ensure constant voltage at normal head of water would not be suitable on a very varying head.

The fall at Bandon is seven feet at the normal height of water. At flood times, owing to the river being restricted below the weir, the tail rises more than the head—a rise of four feet in head giving a rise of nearly seven feet at the tail. The weir runs diagonally across the river, the width of the river being 120 ft., and the length of the crest of the weir 170 ft.

The catchment area of the river at Bandon is 144 sq. miles, and may be taken as typical of Irish catchments. There are mountains about the upper reaches of the river, showing rock very near the surface, and with little or no vegetation. An average area of bog and marsh exists, but the vegetation in the valleys is, perhaps, more than is usually met with. Areas of open water are practically non-existent.

Daily river gaugings have been taken at Bandon since April, 1918, and the following tables abstracted from the records give the average height of water flowing over Bandon weir for every month between April, 1918, and April, 1924, with the rainfall for every month during the same period:

RIVER GAUGINGS AT BANDON IN FEET.

	1918	1919	1920	1921	1922	1923	1924	Average
January ...	—	1.14	1.29	1.34	1.15	.79	1.28	1.16
February ...	—	.94	.96	.98	1.29	1.56	.92	1.10
March ...	—	.83	.79	.87	.87	.88	.57	.80
April	.55	.52	1.17	.51	.46	.35	.47	.66
May	.31	.61	.73	.34	.48	.42	—	.48
June	.09	.30	.27	.15	.19	.04	—	.15
July	.12	.04	.39	.17	.23	.04	—	.16
August ...	.21	.06	.48	.34	.50	.40	—	.33
September ...	.82	.20	.47	.30	.47	.78	—	.50
October ...	.96	.16	.95	.63	.51	.81	—	.67
November ...	.96	.22	.96	.80	.64	.82	—	.75
December ...	1.60	1.33	1.32	.84	.91	.86	—	1.14

RAINFALL IN CATCHMENT AREA IN INCHES.

	1918	1919	1920	1921	1922	1923	1924	Average
January ...	—	6.44	10.40	6.38	9.81	3.65	10.17	7.80
February ...	—	5.76	3.73	3.74	8.10	12.28	3.46	6.54
March ...	—	4.65	5.58	6.10	4.03	4.31	1.93	4.34
April	1.96	3.62	9.59	1.16	3.74	7.68	3.89	4.41
May	2.58	4.00	6.75	3.01	3.26	1.31	—	3.58
June	1.58	1.01	3.84	.08	1.54	.65	—	1.45
July	5.93	1.36	5.25	5.36	5.53	2.83	—	4.37
August ...	3.01	3.88	3.33	5.36	5.03	7.29	—	4.65
September ...	9.31	3.63	4.08	2.74	4.59	5.51	—	4.97
October ...	7.30	1.18	6.04	5.10	3.07	7.55	—	5.02
November ...	5.17	3.22	7.40	8.09	3.42	4.40	—	5.28
December ...	12.41	10.10	8.45	5.45	7.50	4.42	—	8.05
Totals ...		48.85	74.35	51.57	59.62	61.88	—	—

It is impossible to lay down any hard and fast rules definitely to determine the variations of the river from even the most exhaustive statistics of the rainfall. If, for instance, heavy rain during 24 hours is followed immediately by severe frost, the river, owing to its smaller tributaries getting bound up, will not rise as high and will fall faster than if there was no frost. Again, if a long spell of frost terminates in rain the river will rise higher and fall more slowly than if there was no frost previously owing to the rain not being able to percolate at first, and to the thaw and the loosening of the smaller tributaries adding to the flood later on. In calculations of the probable power available from any river by means of rainfall statistics alone the most important factor is the correct estimation of evaporation and other losses. This is also one of the most elusive of the whole series of problems which lie between rainfall and the electric lamps or motors of the consumer. Speaking from practical experience and observation, the author has no hesitation in saying that it is quite possible during the period of maximum temperature and maximum vegetation for as much as 80 per cent. of three or four months' rainfall to pass off in evaporation and losses of various kinds. From the mean average heights of water for the months of the year the mean average monthly rates of flow of the river have been calculated as follows:—

	Cu. ft. per min.		Cu. ft. per min.
January	42,000	July	2,000
February	39,100	August	6,400
March	23,800	September	11,700
April	17,500	October	17,800
May	11,000	November	21,900
June	1,800	December	40,800

From the mean average flow of the river the possible output of the plant is as follows:—

Month.	River capacity kW.	Plant capacity kW. 80% efficiency.	Plant output. Possible kWh.
January ...	290	100	74,400
February ...	270	100	67,200
March ...	160	100	74,400
April	122	100	72,000
May	77	62	46,100
June	13	10	7,200
July	14	11	8,100
August ...	45	36	26,700
September ...	82	66	47,500
October ...	124	100	74,400
November ...	153	100	72,000
December ...	285	100	74,400
Average ...	136	73	644,400

The average annual capacity of the river is 136 kW, the average annual capacity of the plant is 73 kW, and the average possible annual output of the plant is 644,400 kWh, but to make the paper complete some disappointing facts which give some disappointing figures must now be stated.

The difference between the summer minimum capacity of the river (13 kW) and the winter maximum (290 kW) shows how misleading some of the expressions used in connection with hydro-electric development can be. The expression "average annual capacity" has no practical meaning when applied to a river unless that river has storage capacity sufficient to enable the average rate of flow to be maintained over the whole year, or over a series of years. Unfortunately there are people who, on learning that the Bandon river has an average annual capacity of 137 kW, immediately think of prosperous small industries in and about Bandon taking about 200 h.p. day and night all the year round from the Bandon river—at something less than 1d. per kWh perhaps—but the Bandon river, working as an isolated station without an auxiliary generating plant, could not be guaranteed to give even 10 h.p. continuously to any industry.

Again, the "average annual output" of the plant installed at Bandon is 644,400 kWh, but under the best possible demand obtainable in Bandon the actual output from the plant does not reach even one-sixth of that figure. I give the actual output to the town for the year 1923, this being the most favourable year since the plant started.

Month.	kWh from water.	kWh from auxiliary.	Total.
January	11,087	—	11,087
February	8,007	460	8,467
March	8,560	—	8,560
April	7,086	—	7,086
May	5,024	300	5,324
June	1,246	2,986	4,232
July	1,024	3,717	4,741
August	3,518	4,547	8,065
September	9,205	—	9,205
October	12,673	—	12,673
November	14,074	320	14,394
December	14,323	246	14,569
Year 1923 ...	95,827	12,576	108,403

The 95,827 kWh actually generated by the 100-kW plant installed at Bandon falls a very long way short of the 644,400 kWh estimated average annual output available! Without the storage battery this actual output figure would be very much worse than it is, as the gas engine set would be required much more often than it has been to meet every demand, no matter how small, which exceeded the capacity of the plant or the capacity of the river.

The efficiency curves for the Lawaczeck turbines and for the vertical shaft dynamos were supplied by Messrs. Jas. Gordon & Co., and show that, while the efficiency is rather low up to about half load, it reaches 85 per cent. between seven-eighths load and full load. The dynamo curve shows the usual efficiency with low-speed machines, being practically 85 per cent. for all loads between half load and full. To check the efficiency of the plant many practical tests have been made, and the results invariably work out the same.

The necessity for the auxiliary plant and the disappointing output from the water-power plant are due to the two extremes:—(1) Demand for power with no water available, and (2) water available with no demand for power. Storage of water would overcome the former, but the low fall and the value of land put that out of the question—in Bandon at any rate it is not a financially sound proposition.

Filling the valleys in the load curves with some natural industrial demand would help towards overcoming the latter; but the tendency of the present industrial demand is not to spread itself evenly over the 24 hours to accommodate electricity supply undertakings; rather is it to concentrate on a shorter day, giving higher peaks and deeper valleys in the load curves. In Bandon the possibility of supplying a natural night demand was investigated—the heating of bakers' ovens. Owing to opposition to night-work the proposal was not considered, even though an offer of 1d. per kWh was made. Heating water at night for use next day and charging batteries for electric vehicles are at present being investigated, but at their best are only minor applications of natural demands which could be introduced to supply an off-peak load.

The only other means is the introduction of an "artificial" demand. But applied to the undertaking at Bandon, what kind of a load should it be? It should be a load of about 100 kW, and in winter, when power is available, it should come on about 12 o'clock midnight and go off at 6.30 a.m., coming on partially again after sunrise, and going off at sunset. It should, however, come on nearly full at about one o'clock when the other power users are at dinner, and on Sundays, Bank Holidays, or any other odd times, when the ordinary users do not require the power. It should not come on at all during the low water period, but should always be available at a few hours' notice if there should be sufficient rain. It may be said that I have endeavoured to make this artificial load look ridiculous, but a study of my load curves will show that I have stated exactly the kind of load required to fill the valleys in my load curves. It is exactly the kind of load which would be required by any other hydro-electric undertaking supplying also an average Irish demand to make the actual output approach anything near the ideal. Such a load is impossible, and any undertaking depending for its success on the satisfactory development of such a load is bound to be a failure, as a practical industry capable of being shut down for long periods in summer and capable at all times of accommodating its demand, at a moment's notice, to the requirements of the power station is hardly conceivable. The greater the magnitude of the artificial demand the less conceivable it becomes, as present-day labour will not stand such uncertain employment without being paid off-time when power is not available.

Bandon requires at present only about 120,000 kWh per annum, and the theoretical output of the installed plant is 644,400 kWh per annum, yet to expect that it would be commercially practicable to supply the small requirements of Bandon from the water-power alone would be absurd; it could be done by building dams and flooding large areas, but it would be found wanting. The successful development of Irish water power will not be achieved if it is sought to supply all the power required in the whole country from the water power alone. Probably, as at Bandon, it could be done, but certainly the acid test of "would it pay?" would find such an ambitious scheme just as wanting in proportion to its magnitude as the little isolated scheme at Bandon. The success of hydro-electric development in Ireland lies in the rivers being harnessed only so far as commercially practicable and only in conjunction with auxiliary stations.

Some Radio-Telegraph Developments.

I.E.E. Wireless Section: Chairman's Address.—*Abstract.*

By E. H. SHAUGHNESSY, O.B.E., M.I.E.E.

We have brought into commercial service the coupled circuit for the 250-kW arc at Leafield (particulars of which development I gave in my 1923 address *) and to-day no trouble from "mush" or harmonics is observed and it is possible to receive broadcast in close proximity to the station. The primary condenser is made of steel tanks containing 17 aluminium plates immersed in oil. Each unit has a capacity of 6,500 $\mu\mu$F, and four units are joined in parallel. The condenser contains 5,000 gallons of oil and weighs 25 tons. Under working conditions the condenser may handle as much as 260 amperes at 12,350 m. The working voltage (r.m.s.) is 68,000 (equivalent to a peak value of 96,000), and the power handled is 18,000 kVA. The oil is cleaned and dried by a De Laval dehydrator and there has been no breakdown of the dielectric in use. The losses in the condenser are extremely small.

The primary coil is of copper strip made up in 8 flat spirals each containing 8 turns. The strip is carried direct on wooden spiders. The four lower spirals can be moved under the top four, the whole thus constituting a large variometer. The coupling between the aerial and primary circuits is obtained by inserting a fixed coil of 4 turns of copper strip in the aerial circuit, and inside this a rotatable coil of 4 turns of copper strip which is connected to the primary circuit. This coupler has a tendency to warm and is being replaced by one made of stranded wire. With the 250-kW arcs at Leafield when used on 12,350 m. there is no increase in the power consumed for the coupled circuit over that required for the plain aerial, while on 8,750 m. the power consumption is

* ELEC. REV., November 30th, 1923; p. 807.

actually less. Signalling is still done on the marking and spacing waves by varying the inductance of the primary circuit, the secondary or aerial circuit not being altered in tune. This is the largest coupled arc in existence working regularly and satisfactorily, and the constancy of the frequency is extremely good.

Aerial Tuning Coils.—It is generally understood that stranded wire is better for aerial tuning coils than copper strip. At the Northolt station a copper-tube coil was in use which had the very high resistance of about 3½ ohms. It was decided to replace this with a stranded-wire coil made up on wooden pancake spiders. The cable was made up of 729 strands of No. 33 S.W.G. enamel-insulated wire. When the cable was tested it was found that the insulation between wires and strands was faulty. A new length of similar cable with slightly thicker enamel insulation and silk insulation round each group of 81 wires was manufactured. When the

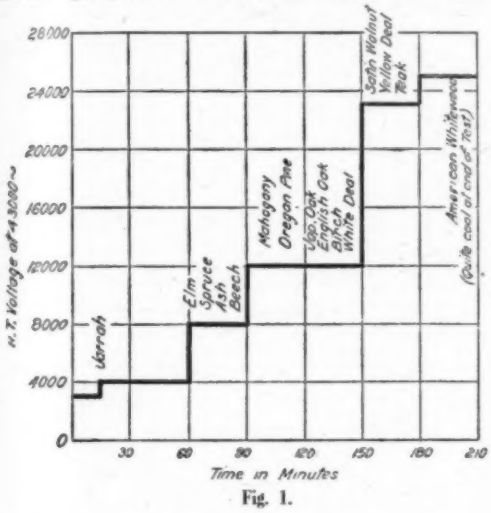

Fig. 1.

faulty cable was made up into the coil and the spiders were adjusted to give an inductance of 1,680 μH its resistance was 2.05 ohms at a frequency of 43 kilocycles, whereas the new coil's resistance was only 0.776 ohm; thus, the insulation of the individual wires is a very important matter.

Dielectric Properties of Woods.—Another matter of importance in the design of the inductance coils for high-power stations is the selection of the material for supporting the cable, and most of the insulating materials available tend to become hot and in many cases end in smoke under the prolonged application of high-frequency voltage. Last year I showed samples of vitrified porcelain which had cracked and from which molten porcelain had oozed out, and I stated that good dry whitewood withstood the tests as well as anything else. There appears to be no information available as to the properties of the various kinds of woods for this purpose; accordingly, varieties of wood were subjected to a practical test and fig. 1 shows the steps in which the voltage was raised and the length of the time during which each particular voltage was applied to the samples. American whitewood is superior to any of the other woods tested and inductance coils made of it have given every satisfaction. Such a coil at Northolt has proved to be capable of carrying 115 amperes, the voltage at the aerial end approximating to 60,000.

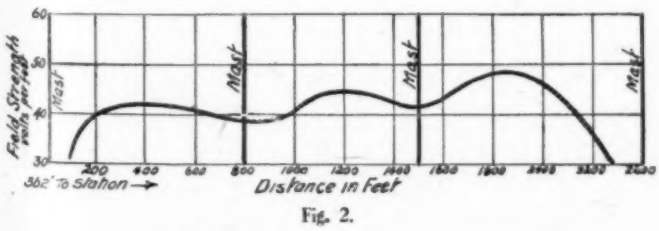

Fig. 2.

Electric Field under Aerial.—It would appear that very low resistance can be obtained with an "earth" consisting of either elevated screen wires, or buried earth wires, led back on distributing elevated conductors with inductances inserted to balance the currents which each of these carries. To investigate these claims the field under the Leafield aerial was explored, the basis of the method being the fact that a neon lamp, when held in a strong electric field with one electrode earthed and the other raised above the earth, glows when the potential drop from the insulated electrode to earth equals the striking voltage of the lamp.

The lettered dotted lines on the inset plan of the aerial system in fig. 3 indicate the lines along which readings were taken; the earth system extends only so far as midway between the second and third pair of masts. The curves show that at a distance from the edge of the aerial equal to its height (300 ft.) there is a field of one-third the maximum intensity which occurs down the centre lines of the aerial. The field under the lead-in, curve A, is much stronger than elsewhere; therefore, the curves B, C and D show that the earth system has no appreciable effect on the distribution of the electric field under the aerial. Curve 2, taken down the centre line of the aerial, indicates a slight increase in the strength of the field towards the end furthest from the station. The effect of uneven ground on the field strength indicated that a rise in height of 5 ft., or 2 per cent. of the total height of the aerial, caused a much greater percentage increase in the field strength. Curves in fig. 4 illustrate the screening effect of the masts and stays.

The Rugby Station.—The site is at Hillmorton, about three miles from Rugby, and is about 900 acres in extent. The building is to be about the centre of the site. Twelve steel masts, 820 ft. high and spaced 1,320 ft. apart, are of lattice-steel construction, triangular in form with 10-ft. sides, and are being built by Messrs. Head, Wrightson and Co., of

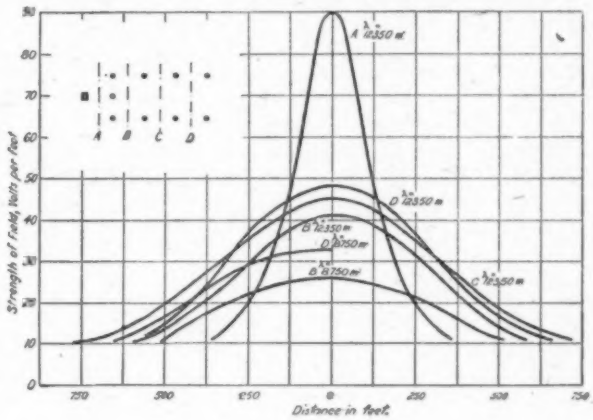

Fig. 3.

Thornaby-on-Tees. Each mast is supported on a ball-and-socket joint resting on a series of 12 porcelain insulators, the whole being supported on a granite block carried by a stanchion fixed to the foundations. A hoist is provided inside each mast with a platform at each position where stays are terminated, and there is also a continuous ladder from the bottom to the top. Each mast is designed to stand a wind pressure of 60 lb. per sq. ft. of exposed surface and to support a horizontal load of 10 tons and a vertical load of 3 tons due to the antenna pull at the top.

The insulators are of special porcelain of flat circular shape, 8 in. diameter and 3½ in. thick. Each insulator has to withstand a test pressure of 25,000 volts at 50,000 cycles per second for 6 hours without showing signs of heating and is, in addition, subjected to a test load of 270 tons. Each mast will have three sets of five stays, anchored at 200, 400 and 600 ft., made of 151 No. 10 S.W.G. wires laid up straight. The

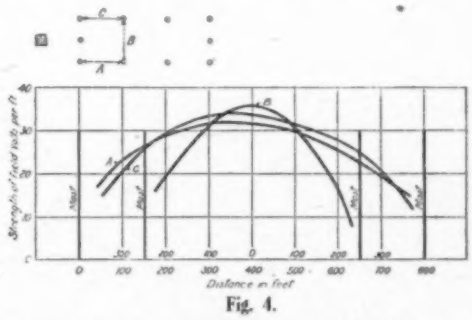

Fig. 4.

aerial will consist of a continuous sausage of 12 ft. diameter, the supporting steel rope being carried down the centre of each mast and wound on a winch with slipping gear which will allow it to pay out when the tension exceeds 10 tons.

The primary circuit consists of a stranded wire cable inductance and Dubilier mica condensers. The aerial coil will also be of stranded cable. Three-phase power at 50 cycles and 12,000 volts is to be obtained from the Leicestershire and Warwickshire Electric Power Co. Three motor-generators to give 6,000 volts each are arranged to be switched in series as required, so that any d.c. voltage up to 18,000 can be obtained. These machines are being made by the British Thomson-Houston Co. Water-cooled valves, each having an output of 10 kW and being made in this country by the Western Electric Co., will be used to make up the high-frequency generator.

General Review.—The cost of one 820-ft. mast may be anything from £12,000 to £15,000, and 12 such masts with aerial and earth systems complete may cost from £150,000 to £180,000. The total cost of a high-power world-wide station

may be between £400,000 and £500,000, and in order to institute a service two stations are required. The interest and depreciation on these amounts are heavy annual charges and the total working expenses may amount to from £70,000 to £96,000 per station per annum, according to the amount of traffic dealt with.

To-day we have a choice of three systems for the internal equipment of high-power long-wave sending stations—by high-power I mean stations of over 200 kW—namely, the high-frequency alternator, the Poulsen arc, and the valve generator, and the art has not yet reached a stage where it can definitely be said which of these will best survive the test of time. The monopoly due to fundamental patents has practically disappeared, and in view of the heavy cost of the aerial and earth systems, the total cost of equipping a high-power station is not materially affected by the choice of any one of the above systems of internal sending plant. Speaking from experience, now that we have solved the problem of eliminating disturbances from the Poulsen-arc emissions, that system may be said to be by no means obsolete. It has advantages of its own in that it is very simple to work and maintain, can be started quickly and can have its working wave-length changed fairly rapidly.

Marconi concludes that with a beam system working on 92 m. with comparatively small powers good communication can be obtained over extreme distances during the hours of darkness—an average of 7 hours per day—while over much shorter distances (2,670 miles) an average of 18 hours' communication per day can be obtained, communication to be at the rate of 100 words per minute, exclusive of repetitions to secure accuracy.

The Post Office has entered into a contract with the Marconi Co. for the latter to provide a station to work to Canada as above at a cost of £50,420—the station to be capable of extensions to work to South Africa, India, and Australia simultaneously, each extension costing £31,406. As the capital cost of these stations is low, depreciation and interest will be low and the power will also be comparatively low, but the cost of operating will depend upon the number of hours during which communication is satisfactory, and also upon the rate of working.

It seems essential that high-power long-wave stations must be erected in order to provide for a full and regular Imperial telegraph service in which there shall be no initial delay due to ordinary telegrams having to be kept in hand until the favourable hours of working arrive, and also to be able to reach any and all parts of the Empire at any moment. The erection of the short-wave beam stations will show to what extent they can assist in cheapening the cost of transmitting the less urgent forms of telegraph traffic and in reducing the number of high-power stations required in this country to meet the demands of a full Imperial radio-telegraph scheme.

Kinema Lightning.—In the studio the imitation of natural lightning as a scenic effect is the end sought, and "lightning" has been successfully reproduced by ingenious electrical and photographic work. Various early methods were employed, but a new device that has been tried in California is declared to be the most satisfactory thing of its kind that has yet appeared. This apparatus produces "sheet lightning," and is known as an electrically-operated lightning torch; it was perfected by Mr. Arthur E. Shadur, chief engineer at Universal City, and the particular advantage over previous devices is its element of safety, says the American G.E.C.

The apparatus consists of a receptacle holding powdered aluminium which is ejected, under air pressure, past a check valve and against an electric arc. The intense heat of the latter ignites the powdered aluminium, producing a powerful flash, remote control enabling the "movie" director to merely press a button and produce the flash. The valve through which the powder is forced closes an instant before the arc ignites the aluminium, thus preventing the apparatus from backfiring and exploding; also insuring the safety both of operators and of persons near by. Forked lightning effects are secured by first photographing cloud formations which are suggestive of storm, or by photographing on several hundred feet of film an ordinary landscape with the horizon low in the picture, thus showing quite an expanse of sky. Then the film is run through the machine a second time, but this time with the camera aimed at a curtain of black velvet, and at several points terminals leading to high-pressure electric generating apparatus are used to cause spark-overs, which wriggle vividly across the whole picture, the camera being but a few feet distant. The film is then developed.

A Large American Searchlight.—What is said to be the most powerful electric searchlight in the world, with a normal range of more than 50 miles, has been put in operation on Staten Island, New York. It is part of the equipment of the United States Lighthouse Service, and was developed by the Government in an effort to produce a light more powerful than any hitherto built. A single electric lamp of approximately five billion (5,000 million) candle-power supplies the beam, and this beam is reflected as a brilliant shaft of light by a series of high-power lenses. On a clear night the beacon has been reported as visible in Philadelphia, more than 80 miles away.—*Electrical World.*

Published Specifications.

Compiled expressly for this journal by Patent Agents.

The name of the applicant's patent agent, if any, will be found on the printed specification.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

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15,418. "Radio-signalling apparatus for use in ships and the like." Dr. C. Valguarnera. June 13th, 1923. (225,894.)

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20,461. "Wireless systems." T. H. Kinman. August 11th, 1923. (225,907.)

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24,212. "Sound-emitting sinker for sounding depths." H. Baron (Signal Ges.). September 28th, 1923. (225,968.)

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24,995. "Inductance devices." Western Electric Co., Ltd. (Western Electric Co., Inc.). October 8th, 1923. (Patent of addition not granted.) (225,973.)

25,061. "Interchangeable high-tension battery and adaptor." T. Underdown. October 8th, 1923. (225,975.)

25,269. "Loud-speaking telephones." British Thomson-Houston Co., Ltd., A. P. Young, and J. H. Butcher. October 10th, 1923. (Cognate application 1,479/24.) (225,976.)

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27,933. "Electric switches for dealing with large surgings of electric current." Akt. Ges. Brown, Boveri et Cie. November 6th, 1922. (206,522.)

27,936. "Brush mounting for electric motors." P. T. King. November 6th, 1923. (226,002.)

28,352. "Adjusting devices for instruments used in wireless telegraphy." C. J. Owen. November 10th, 1923. (226,005.)

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